JPRS-UMM-84-014

31 July 1984

USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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[Article by D. Platerovich, senior scientific associate at the Economics Institute of the USSR Academy of Sciences, doctor of economic sciences, and professor: "Structural Policy in the Production and Utilization of Machinery"]

[Text] Increasing the efficiency of national production and utilization of achievements in scientific and technical progress for this purpose depend to a great extent on the development of machine building and its ability to provide all sectors of the national economy with highly productive and economical implements of labor. A number of economists are of the opinion that a discrepancy between the development of machine building and the demands of the national economy is the primary reason behind the inadequate rate at which manual labor is being replaced by mechanized means, the production apparatus is being renewed, and enterprises are undergoing technical retooling. This is the reasoning behind the proposal to make a sharp increase in the capital investments in machine building at the expense of other sectors, which is difficult to carry out in practice without causing some damage to the fulfillment of the food, power, and other important social and economic programs.

Production in machine building and metalworking is growing at a very rapid rate. Between 1970 and 1983 the value of production in these sectors increased by a factor of 3; in 1975 production in these sectors accounted for 20 percent of the total volume of industrial production, by 1983 it had grown to 26 percent. Why then, with this substantial increase in machine building production, are some types of equipment in short supply? It seems to us that the reasons are hidden primarily in the characteristics of the structure of implements of labor which are being produced and used, and in shortcomings in the technical and structural policies in this particular sector of industry.

For the structural policy to become an effective means for meeting the requirements of the law of planned development of the national economy, the structure of all types and varieties of goods being produced should be the object of constant analysis, planning, and control. This applies especially to implements of labor because of their close technological ties, both among themselves and with objects of labor and finished products.

In addition to this, implements of labor are the most mobile elements of production. The effect that the contemporary scientific and technical revolution has on production is manifested primarily in changes in the structure of implements of labor.

The formation of the structure of machinery begins with the creation of an initial scientific and technical project. Structural changes successively include first the sphere of developing designs and creating models of new equipment, then the production of the equipment, and finally, the operating machinery pool.

The effect of structural shifts on the social and economic efficiency of production depends first on the proportion of progressive equipment used not in the production of machinery, but in the volume of products produced with the help of this equipment. In addition, this aspect of the structure of equipment, like other ratios in the composition of the equipment pool and equipment production, as a rule is not only not an object of planning, but even of statistical accounting and economic analysis.

The methods for this type of analysis have not been adequately developed. National economic plans, as well as the Comprehensive Program for Scientific and Technical Progress, are usually lacking a structural point of view. In the planning of machinery production, the primary emphasis is usually placed on production volume and rate of growth, and not on adherence to technologically and economically-based ratios between different types and models of equipment, weight and cost, capacity and productivity, and sectorial and functional purposes.

As a result of a poorly developed and inadequately focused structural policy in the planning of production output and formation of the machinery pool, serious discrepancies arise in the production appparatus, which reduce the possible scale of application and efficiency level of means of mechanization and automation.

In a number of sectors the size of the pool of several types of equipment, especially traditional equipment, exceeds by a significant margin the economically-based demand under normal use, since there are shortages of other types of equipment. For example, there are about 2 metal-cutting machine tools for every machine tool operator in the national economy. In spite of the increase in this discrepancy and the low level of utilization of a significant portion of the machine tool pool, the pool continues to grow, while there is inadequate production of equipment for assembly operations.

In construction, the pool of digging equipment--excavators, bulldozers, and earth moving machinery--increased from 90,000 units in 1960 to 371,000 units in 1982; that is, it increased by a factor of over 4. The number of these machines in many construction organizations is significantly higher than what is required by the standards that have been set; in recent years their level of utilization and output per unit of the basic parameter have declined. However, the output of these machines (primarily the small and medium-capacity equipment) is growing. In 1982 the output was almost 96,000 units. But the demand in construction for bulldozers, large-capacity loading equipment,

excavators, leveling machines, other machinery for small-scale jobs, equipment for finishing work, and mechanized instruments was not met.

Of course, capacities intended for the production of various types of equipment are not interchangeable; improving the list of machine building products being put out usually requires significant reconstruction of enterprises. Therefore, the structural policy should be developed on a long-term basis and it should reflect the long-range demand for implements of labor and trends in the changes of designs, technology, and organization of production.

In our view, the most important changes in the implements of labor that are tied to the contemporary stage of scientific, technical, social, and economic development can be summarized as follows. In the first place, progressive implements of labor are intensively expanding the sphere of their application, both within physical production, and beyond its limits--in education, health care, and other social services, as well as in the sphere of everyday life. In the second place, the processes of creating and introducing fundamentally new equipment and technology are being accelerated; a pool of contemporary equipment is being formed gradually, which makes it possible to change both the means of exerting a technological influence on an object of labor, as well the relationship among automated, mechanized, and manual production processes, and the character of man's interaction with machinery. In the third place, the interaction among different elements of means of labor is becoming more complex, and it is becoming necessary to make a transition from separate machinery and mechanisms to systems and complex machinery, that include all stages and technological operations of producing goods and services. In the fourth place, there is a sharp increase in the role of the social effectiveness of means of labor, which requires that equipment be produced that is aimed at resolving problems, such as improving working conditions, protecting the environment, and so on. In the fifth place, the process of reproducing the equipment pool is speeding up, which is reflected in more rapid replacement of equipment, in the amortization policy, and in the allocation of new equipment resources to meet the needs of expansion and replacement of the pool.

These characteristics of the contemporary development of implements of labor have various effects on the level of utilization of the equipment pool, the capital-output ratio, and the machinery-output ratio; in connection with this, the growth in the effectiveness of implements of labor should become a specific object of planning and control.

The structure of implements of labor is complex and multidimensional; it has a whole series of different aspects. An analysis of each of these reveals certain national economic, sectorial, technological, dimensional, organizational, or reproduction proportions.

Economic research in this direction should include the sectorial, functional, technological, type size, and age structure of the implements of labor.

The sectorial structure, that is, the relationship among the amounts of equipment concentrated in various sectors of the economy, depends on the scale of the sector, the character of the technology, and the level of the technical machine-worker ratio in each sector, how well it is supplied with manpower

resources, and the ability of machine building to provide various production sectors with equipment. For example, the capital-labor ratio and machine-worker ratio in agriculture and in the majority of other nonindustrial sectors are lower than in industry. Therefore, it is extremely important to step up the technical equipment of these sectors, which will provide an increase in the rate of growth of labor productivity.

Even though it is growing at a rapid rate, in 1981 the capital-labor ratio in agriculture was about 62 percent, and the machine-worker ratio was 32 percent of the level reached in industry. In the sphere of everyday services, the capital-labor ratio is one-sixth that of industry and two-sevenths that of agriculture; it is ten-seventeenths to five-fourteenths that found in related sectors of light industry. As a result, over 76 percent of all workers in the production sectors of the services sphere are engaged in manual labor, while in industry less than half are, and in construction, about 60 percent are. Further increases in the production and improving the utilization of machinery for agriculture and everyday services enterprises will bring about a significant rise in the level of mechanized labor in these sectors.

The functional structure can be formed depending on the role played by equipment in production: whether it serves basic or ancillary processes; whether it applies to power and operating machinery, means of transport, or control equipment. An analysis of these and several other aspects of the functional structure of implements of labor makes it possible to reveal disparities that reduce their effectiveness.

For example, as a result of uneven technical equipment, usually 70-80 percent of basic production in industry is mechanized, and 25-30 percent of ancillary production is mechanized. A series of studies showed that freeing up one worker engaged in ancillary operations (especially materials handling and warehousing services) requires approximately one-third the expenditures required for freeing up one worker engaged in basic production. In light of this, the programs for mechanization of manual labor and the development of machine building that are now being developed should place special emphasis on accelerated growth in the production of equipment for materials handling, warehousing, repair, and other ancillary services.

As a result of a less than optimal relationship between power and operating or transport machines in agriculture, large, high-powered tractors are often used at half-capacity, and the capacity of locomotives in rail transport is underutilized. When there is a shortage of large-capacity dump trucks at quarries, the productivity of excavators is underutilized. The possibilities of computers often go unused because of a shortage of peripheral equipment or software. Electrical chargers sometimes stand idle because of a shortage of storage batteries; tractors and motor vehicles often stand idle because of a shortage of spare parts, and so on. Improving the functional structure opens up reserves for making fundamental improvements in the utilization of many types of equipment and reducing the demand for the equipment.

In an analysis of the technogical structure, the relationships among equipment for interchangeable types of manufacturing processes takes on key importance. It is here that one determines the proportion of equipment for fundamentally

new, highly productive technological processes and of automated equipment; the level of complexity in mechanization and automation; and the extent to which they include various technological processes.

For example, in electrical power engineering, the proportion of equipment for thermal, atomic, and hydroelectric power stations is an important aspect of the technological structure; in ferrous metallurgy, the proportion of Martens furnaces, oxygen converters, and electric furnaces is important; in machine building, the proportion of machine tools for mechanical processing of metal and for processing metal by electrophysical, electrochemical, laser, and other fundamentally new methods is important; in construction, the proportion of excavators, bulldozers, earth-moving equipment, dredgers, and so forth is important. An analysis of the technological structure is needed to determine how progressive the equipment that is being produced and used is, and to make decisions aimed at increasing the equipment's efficiency.

There are many examples that prove that the mechanism for selecting the most effective technical and technological solutions often does not work. In machine building the sphere of application of machine tools for electrophysical and electrochemical processing, machines for plasma-cutting of metal, the production of parts from powders, electric heating furnaces to replace cupola furnaces, and so forth, is not expanding fast enough. It is very effective to replace some of the traditional metalworking equipment with component rolling mills, which increase labor productivity by a factor of 7-25, provide a 15-30 percent savings of metal, and increase the durability of parts and stampings by 30-50 percent. By the beginning of the current five-year plan there were 92 such mills in operation in machine building; they were manufactured by plants of the Ministry of Heavy and Transport Machine Building and produced only a small share of the machine building parts and stampings. But during the current five-year plan the output of these mills is lagging behind the quotas that were set. Doesn't this provide evidence of the redistribution of capital investments and other resources allocated for the development of traditional equipment, in favor of more progressive types of equipment?

The goals for improving the technological structure are inseparable from the complex problems of developing and incorporating new equipment, selecting the most effective directions and variations, and improving planning of and incentives for scientific and technical progress at all levels of economic management. Here one can see especially clearly the close tie between structural and technical policy.

The type size structure, that is, the relationship among various types and sizes of machinery within each technological group, can be based on the power, carrying capacity, unit productivity, the sizes of components being processed, and speed and other technical parameters. The efficiency with which machines are used in each sphere of their application depends on the correspondence between the type size structure and the character of the components being processed or the operations being performed.

We examined reserves tied to improving the type size structure in a special study based on the most important sectors of the national economy and industry.

We will start with machine building. In the 1960s and 1970s, at the Metal-Cutting Mills Experimental Scientific Research Institute, and other scientific research institutes and design bureaus, studies were made of the utilization of the parameters of various groups of metal-cutting machine tools. In terms of their size parameters, the machine tools were utilized, as a rule, no more than 50 percent, and when a large share of the components were being machined, their utilization was only 20-30 percent. Utilization of the speed and feeding potential was even worse.

In other words, in the majority of cases larger, more powerful, and more expensive machine tools are used than what is needed to machine the given components. According to calculations made by V. N. Anikeyev, even a very modest improvement in the correspondence between the type size structure and the components being machined in just two industrial groups of metal-cutting machine tools--lathes and vertical drills--could decrease the cost of the annual output at enterprises of the Ministry of the Machine Tool and Tool Building Industry by 56 million rubles. Thus, with this structural shift the cost of the entire pool of these two groups of machine tools would decrease by about 0.5 billion rubles.

It would be wrong, however, to think that the problem of utilizing the technical possibilities of machine tools is the same as it was in the 1960s. Scientific and technical progress, primarily automation processes, has introduced new aspects into this problem, which are often more important economically than utilization of the size parameters or engine capacities.

One of the most important aspects is realization of the potential of machine tools with numerical programmed control, the cost of which is often several times, or tens of times, higher than the cost of nonautomated machine tools. Numerous cases have been reported of utilization of these machine tools without any program, using them to machine simple components, utilization of especially expensive multi-instrument machine tools with just one or two instruments, and so forth. As a result, large outlays on equipment with numerical programmed control result in losses, and the pay-off period often runs into decades.

The issue of the type size structure of this kind of equipment, and rational coordination of multi-operational, single-operational, and simplified designs and various systems of control, is even more complicated than the question of the structure of ordinary machine tools. It is impossible to solve these problems without an extensive and thorough examination of the utilization of equipment with numerical programmed control.

The growing use of automatic feeding devices, manipulators, and industrial robots complicates even further the task of improving the utilization of equipment parameters. Because of the lack correspondence between the possibilities of a system controlling the operating speed of an automatic feeding device and the technological possibilities of the machining equipment, the quality of the stampings, or the instrument, two types of disparities can arise: either an insufficient automatic feeding speed prevents full utilization of the potential of the machine tool or press; or the quality of the stampings or the instrument prevents utilization of automatic control systems that do not have the capacity to self-adjust in response to the size of

the allowance on the stampings, and so forth. For example, of the 95 press strokes per minute that are available in a set of stamping equipment with the AKK-100Pr automatic manipulator, only 6 are used, or 6 percent of the manufacturing machine's potential.

Thus, automation makes certain demands on the equipment designers; an analysis must be made of the equipment's operating conditions, the characteristics of the components being machined, and the correspondence between the parameters of all the equipment in the automated complexes, and the nature of the operations they perform. Automation often turns out to be economically inefficient because of the absence of an analysis of this type.

Among the other types of equipment in the machining industry whose parameters do not correspond adequately to the nature of the object being produced and the operations being performed, we can name: forging and pressing equipment whose capacity and speed do not always meet the demands of the particular production process; looms whose insertion width does not always correspond to the width of the fabric being woven; crane equipment at machine building enterprises--often only one-third of its capacity is used; general-purpose compressors--in many instances no more than 50 percent of their engine capacity is utilized; and low-voltage electrical equipment. The potential of this equipment in terms of capacity, strength of current, number of circuits used, resistance to mechanical wear, and so on, often exceeds production demands.

All this results in extra capital and current expenditures tied to the acquisition and operation of equipment, and in over-consumption of metal, fuel, electrical power, production space, and so forth.

The efficiency of equipment in the extractive industry depends to a great extent on how it corresponds to the conditions of extracting minerals: to the nature and depth of the deposit, to the thickness of the beds being mined, and so on. When these conditions vary greatly, there is a need to differentiate and optimize the type size structure of extracting equipment and to utilize each machine in the basin, mine, face, etc., where its capacity and other parameters will be used as fully as possible.

In the extractive industry it is especially important to have close coordination of equipment used directly in mining (for breaking up and extracting rock), and transport and concentrating equipment. When their capacities and productivity do not correspond, it is necessary to shut down some equipment, to operate some machinery at half-capacity, or to refrain from using progressive equipment altogether. For example, mining machine building produces powerful rotary excavators with a capacity of 1000-5000 m^3 of rock per hour; these machines are being used successfully at a number of large quarries in the construction material industry, and the cement, fireproofing, and other sectors. In these sectors, however, medium-sized and small quarries are predominant, not large quarries; at the small and medium-sized quarries there are no compact rotary complexes (with a capacity of 200-600 m^3/hr), so it is necessary to use the single-bucket excavators, which are significantly less efficient. The demand for compact rotary excavators is so great, that some quarries have started to manufacture them with their own resources.

Because the coal industry lacks special types of combines and mechanized complexes for working thin or steep beds, in a number of cases it is necessary to use equipment that does not correspond totally to the conditions for extracting the coal. A result of this can be either the loss of coal that gets left behind in the bed (if, for example, the complexes cannot reach the entire thickness of the coal bed because of the height of the timbering, or the width of the auger combine's operating arm), or coal is contaminated by waste rock, which is dug up by an auger whose diameter is too large, or caves in when improper timbering is used. According to data from research done by the Donetsk Coal Scientific Research Institute, in recent years more and more mechanized complexes that do not correspond to the extraction conditions are being introduced at small beds (up to 1.2 m), where in addition to coal, they "extract" millions of tons of waste rock lying next to the coal beds.

In light of this, in the first place it is necessary to promptly develop and produce complexes for various operating conditions and to improve the type size structure of this highly productive equipment so that it corresponds to the conditions encountered in the extraction of coal. In the second place, each type of complex must be sent specifically to those mines where it will be the most efficient. As the research mentioned above indicated, the same type of complex is often used in Ukrainian mines where the beds are of varying thicknesses, which cannot help but lead to underutilization of the equipment's parameters.

Oil-drilling rigs are one of the primary types of equipment for extracting oil and gas. The value of this pool of equipment, together with auxiliary equipment, is in the billions of rubles. Various types of drilling rigs, depending on their hoisting capacity, are designated for drilling wells of varying depths. Serious violations of this correlation, specifically the use of high-capacity rigs to drill shallow wells, leads not only to extra capital investments, but also to a significant over-consumption of metal, electrical power, and fuel, higher operating expenditures, and over-consumption of means for shipping heavy equipment; this is especially important since the extraction of oil and gas is continually moving into more remote and inaccessible regions.

The structure of the truck fleet has been shifted for no sound reason in favor of medium-capacity trucks (2-5 tons), with not enough small-capacity (up to 2 tons) and large-capacity (over 5 tons) trucks. Furthermore, the proportion of flat-bed trucks is too high, while the share of tankers, vans, and other specialized trucks, as well as truck trailers, is too low. The proportion of economical trucks with diesel engines is also too low. Losses to the national economy resulting from the irrational structure of the truck fleet run into billions of rubles.

Research done by the Motor Transport Scientific Research Institute and the Motor Vehicle and Automotive Central Scientific Research Institute showed that the proportion of small-capacity trucks is one-half what it should be. As a result, often several hundred kilograms of freight are shipped on 3-5 tons trucks, which leads to extra expenditures on transport; increases the consumption of metal, fuel, and oil; reduces the capital-output ratio; and increases depreciation, the cost of services, and other operating expenses. Shipping freight weighing 0.5 tons on a truck with a carrying capacity of 2.5

tons increases costs by 30 percent; when the truck has a carrying capacity of 6 tons, costs are double what they would be if the shipping was done on a truck with a 1-ton carrying capacity.

Determination of the economically rational parametric structure for the output and fleet of machinery is a complex optimization task. To resolve this task, one must make a preliminary analysis of the actual utilization of the machinery's technical parameters in their sphere of operation; size series and modifications must be worked out; the size structure of the components being machined and the cargo that is being moved must be determined, and so on. Coordination of the type size structure of equipment and the structure of components or operations assumes the presence of the necessary parametric reserve. For example, if lathes machine components that are over 100 mm in diameter only 10 percent of the time, the demand for lathes that can machine components like this will always be more than 10 percent, since, for example, the stampings for large components may be delivered on an irregular basis. The size of the reserve, however, should be economically sound. In a case like this, an effort to have only lathes that can machine any kind of component, and thus to free oneself from concerns about distribution of work among different types of equipment, should be viewed as an unjustified extravagance.

The aim of research on the age structure of equipment is to obtain information for evaluating the technical level and condition of machinery in order to optimize the process of replacing the machinery pool. It is not enough to know just the distribution of machines by age group (for example, under 5 years, 5-10 years, etc.) in order to make decisions about the service life and rate of replacement of equipment. The optimal service life depends on the pace of scientific and technical progress, changes in the composition of goods being produced, the reliability and durability of equipment, and conditions of its operation, maintenance, and repair.

When analyzing the age structure of a machinery pool, one should consider it unacceptable for part of the equipment to have exceeded its standardized service life. The standardized service life does not represent an extreme limit, but an average value. It is absolutely natural for some machines to go out of service somewhat earlier than others, and for some machines to last somewhat longer than the standardized service life. However, a large proportion of equipment in the older age groups, and especially a rise in this proportion, usually is evidence that obsolete and worn-out machinery is not being replaced adequately. This trend has been seen, for example, in ferrous metallurgy and in the pulp and paper industry, where the withdrawal of machinery and equipment in 1982 was 1.4 and 1.0 percent, respectively, as opposed to 2.2 throughout industry as a whole.

An analysis of the age structure of the equipment pool should be supplemented by a study of shifts in the age structure in the output of machines (based on the number of years since the machinery was first put produced). For instance, between the late 1960s and the early 1980s the proportion of relatively new articles (those being produced no longer than 5 years) in the total volume of production at enterprises under a number of machine building ministries decreased from 55 percent to 36 percent; this is evidence of the need to step up the renewal of machine building production.

There are many different reasons for the disparities that appear in the structure of implements of labor in the various sectors of the national economy. They are tied primarily to shortcomings in the economic management mechanism and the structural policy which is implemented through methods of planning, providing incentives, financing capital investments, and other forms of management activity.

The main goals of structural policy in the production of machinery include: providing rapid growth in the production of those types of equipment for which the demand is being met to the least extent; making as rapid a transition as possible to the production of progressive equipment that will bring the greatest effect to the national economy or that will help resolve important social and economic problems; and reducing the import and increasing the export of equipment.

It seems that these obvious goals are not always being met. For example, inadequate attention is being given to the task of determining the demand for equipment. Considerably exaggerated consumer requests are often used as the basis for estimating demand. Evidence of the poor substantiation of these figures can be seen in the fact that when enterprises receive only 20-40 percent of the requested equipment (which is the case with several groups of metal-cutting machine tools and other machinery), they not only fulfill production plans, they may fail to utilize or they underutilize a significant portion of their equipment pool.

In addition to the application of instruments such as the intersectorial balance, output-machine norms, and breakdowns for separate types of equipment, the structural policy in the production of machines should be based on determining the areas in which the use of manual labor is the most widespread; spheres in which there is an accumulation of old equipment; and production sectors with the greatest need for technical renewal. For instance, in the development of a special integrated program for mechanization of manual labor, which is now being worked on, it is becoming obvious that of the approximately 50 million workers engaged in manual labor in all sectors of the national economy, the majority are concentrated in agriculture, in materials handling and other auxiliary operations, and in the repair sphere and everyday services.

The structural policy in the production of machinery is not directed sufficiently toward overcoming the backwardness of these spheres of production in terms of their level of mechanization. How else can one explain that while the USSR produces considerably more locomotives, metal-cutting machine tools, electric engines, tractors, grain-harvesting combines, excavators, and many other types of machinery, than the United States, it still lags behind in terms of automatic and electric feeders, many agricultural tools, small-scale mechanization equipment, mechanized instruments, and machinery for providing everyday services? What else, besides an inadequately focused structural policy, can explain why with developed metallurgical machine building and its scientific research base, which are capable of producing contemporary equipment to meet the requests of not only domestic, but also foreign metallurgical enterprises, the age structure of the equipment pool in Soviet metallurgy is much less favorable than in other sectors of industry; and it has been allowed

to fall behind in terms of the introduction of continuous casting systems for steel production and several other types of progressive equipment that were first developed in our country?

Practically all sectors of machine building are faced with the tasks of improving the structure of equipment production. In the development of the special integrated program to develop machine building up to the year 2000, in our opinion, improving the structure of its production should be viewed as one of the most important special functions.

In this connection, the structural aspect must be introduced into sectorial, as well as intersectorial (general machine building) sections of the program. There are plans to set special goals in the program for each sector of machine building for improving the technological and type size structure of equipment production. Here the program must adhere to the principles of making gradual increases in the extent to which the demand is met for the most progressive equipment and the equipment that is in the shortest supply, with a final goal of bringing this level to 100 percent by the year 2000 in every possible case. It seems to us that in the general machine building sections of the program it is extremely important to call for elimination of disparities in the sectorial and functional structure of equipment, and for a rapid rise in the production of machinery for the sectors and production spheres that are suffering the worst shortages.

An important direction in the structural policy of machinery production is improving the organizational structure of machine building itself, and making fundamental improvements in the concentration and specialization of production. These problems, however, should be examined separately.

Proceeding from the goals outlined in the program, the structural aspect in all of its variations must be introduced into five-year plans to help realize their program goals. In this work, not one plan quota for machinery production should be set without taking into account the structural proportions between the equipment in question and other types of machinery, instruments or equipment that is connected to it in some way. And not one structural proportion should be established without taking into account its effect on the final national economic result of production.

Of course, disparities can arise also in the course of fulfilling a balanced, structurally-oriented plan, if, for example, the development of designs or capacities for producing some of the machinery included in a complex falls behind the time limits that have been set. Therefore, implementation of the structural aspect of the plan should be under the same strict control as the fulfillment of volume indicators.

Tasks in increasing the economic effectiveness of equipment are resolved at all stages of its development and incorporation. Developers of new models of machinery should include in their designs the dimensions, capacity, and productivity which are truly needed by the consumers. Meanwhile, scientific research institutes and design bureaus that are developing new equipment are striving to increase equipment parameters, regardless of the possibilities for their utilization. Encouraging the estimated efficiency, and not the actual

efficiency of new equipment leads to a situation in which estimates are based on extreme operating conditions for the future equipment, on a high workload, and full utilization of all the additional potential that its design provides. Under actual operating conditions this potential often goes unused, and the actual efficiency turns out to be lower than the estimated efficiency.

In the majority of cases, development of size series of machinery does not lead to assimilation of production of all models or type sizes of equipment called for in the type series. Gross output methods for evaluating economic activity which are based on the quantity of goods produced, inadequate standardization, and other reasons, lead to a situation in which one basic model is developed, production of this one type of machinery is developed rapidly, and other type sizes or modifications of this type of machine either are not produced, or only small quantities are produced, with production at a low technical level. In this case, as a rule, the consumer does not order the machine that corresponds to production conditions, to the size of the goods being produced, and so forth; instead, he orders the machine that is being produced in large quantities, that has managed to prove itself already, for which there is a better supply of spare parts, and so on.

Even though the structure of machinery production is often one of the most important preconditions for forming a rational structure in the machinery pool among consumers, the consumers themselves should carry out purposeful improvement of the structure of machinery that is being used. In a number of cases lack of correspondence between the structure of the pool and the demands is explained not by the fact that the necessary equipment cannot be produced, but that the consumers are not prepared or have no economic incentive to optimize the structure of the equipment pool.

The basic goals of structural policy in the utilization of machinery are to provide full mechanization and automation, a progressive equipment pool, and utilization of each machine in the sphere where it can be used rationally. These goals should be realized in the process of development and implementation of plans for construction, reconstruction, technical retooling of enterprises, and equipment replacement. It is clear that it is expedient to analyze these plans from the standpoint of their effect on the structure of the machinery pool: to what extent will there be an increase in the proportion of progressive automated equipment, which will embody new technological principles, and machinery that corresponds to specific production demands; and to what extent will the new structure change the level of utilization and the return on fixed production capital?

It is important to keep in mind that production resources, particularly living labor and means for its mechanization, are to some degree interchangeable. If incentives are provided for conserving living labor and material resources, and no economic incentives are given for saving capital investments and fixed capital, this will inevitably help reduce the capital-output ratio and consequently, it will contribute to extra expenditures of labor and materials in the capital-creating sectors.

During the course of developing and implementing progressive plans, certain obstacles of a planning, financial, or organizational nature often arise. For

example, on the one hand, plans should exceed the current level of equipment, at least in terms of construction time and the time needed to assimilate new projects, otherwise new capacities inevitably are already obsolete by the time they are put into production. But on the other hand, a plan may include only the equipment that is already in the catalogues, that is, equipment that was developed before work was started on the plan. Furthermore, new proposals for the application of progressive equipment that arise in the process of reconstruction and technical retooling often cannot be implemented, because there is no capital available for the equipment, or (if the equipment has been procured) the Bank for Financing Capital Investments will not pay for it since it was not included in the title lists ahead of time. It may also happen that an enterprise does not have the funds to pay itself, since the assets in the fund for the development of production are practically aimed at financing centrally planned measures. All this undermines initiative and reduces the incentive for associations and enterprises to get involved in the technical retooling of production and forming a progressive equipment pool.

As outlined in the decree issued by the CPSU Central Committee and the USSR Council of Ministers on measures to expand the rights of enterprises, in order to strengthen these incentives it is necessary to increase substantially their practical possibilities in the acquisition of equipment, and, as a rule, to shift to self-financing of technical retooling of existing production. In our opinion, in order to accomplish this it would be expedient to develop wholesale trade in means of production, to grant enterprises the right to do what they wish with production above the plan, and to leave at their disposal production capacity reserves for filling orders to manufacture products in their area of specialization.

Furthermore, expanding the rights of enterprises should be tied to a categorial prohibition against withdrawal or centralization of assets in the fund for development of production, and to increasing the size of these assets by transferring into the fund a large share of the renovation and depreciation deductions for capital repairs.

In order to eliminate the possibility of irrational use of capital investments and investment resources in terms of their material maintenance with this proposed expansion of enterprises' rights, it is important for enterprises to have a true incentive for conserving means of production. This incentive can be created by encouraging growth in the capital-output ratio, improving utilization of production capacities, conserving capital investments, and increasing the equipment workload.

In our opinion, with further improvement in the economic management mechanism the growth of the economic incentive fund should be directly dependent on the dynamics of the capital-output ratio, and the production development fund should be inversely dependent on the capital-output ratio. Since a rise in the capital-output ratio, with other conditions being equal, means a reduction in the demand for means of labor, for every percentage point in the growth of the capital-output ratio, deductions for the development fund should decrease, and the economic incentive fund should increase by a certain percent. Accordingly, for every percentage point that the capital-output ratio decreases, the

development fund should increase, and the economic incentive fund should decrease in accordance with specially developed norms.

Structural policy is implemented in the management process both in terms of the demand for equipment, as well as in terms of the satisfaction of this demand by manufacturers. Meanwhile, the reverse relationship between consumers and the equipment producers does not exist, as a rule. As a result, machine builders do not play a large enough role in forming the optimal structure of the equipment pool among consumers; they study this structure rarely and only to a small extent; and they do not influence the level of utilization of equipment parameters by adjusting the structure of machinery output to correspond to the nature of operations being performed. Technical specifications for the equipment being produced do not indicate specific conditions and spheres for its rational utilization. Meanwhile, the consumer of a metal-cutting machine tool, for example, should know before acquiring the tool how its pay-off period changes depending on the shift system being used, the series production, the complexity of the components being produced, and other production conditions. It seems to us that everyone involved in developing machinery should study these factors and list them in the technical specifications.

How can a producer of equipment be made to care about the efficiency of the equipment in the hands of the consumer? The main obstacles here are, in our opinion, a shortage of several types of equipment and the poor mechanism for selecting efficient designs and solutions. The shortage of equipment leads to a situation in which the producer has absolute power, and often allows him to thrust equipment onto the consumer which is more profitable to produce, and not which is more profitable to operate in the specific sphere in which it is being utilized.

Several economists suggest that a condition for ensuring a sufficient supply of equipment is for the producers to have equipment with reserve capacities. Even though this condition is important, it is not the fundamental condition. After all, the equipment pool is oversaturated with certain traditional types of equipment, and requests for these machines exceed the volume of their production by a factor of 2-3. It is necessary not only to increase capacities for producing this equipment, but also to limit the "appetite" of consumers for acquiring equipment that they cannot utilize efficiently. Apparently, financing for the purchase of new equipment should be provided in accordance with achieving the normative level of utilization of the existing equipment pool. But it is even more important to establish a system in which the savings of funds for acquiring equipment could be partially used to provide incentives for workers who are responsible for the particular savings. This increases the incentive for conserving means of labor and the demand for machinery drops substantially, which forces the machine builders to improve product quality, reduce prices, and to adjust the structure of machinery being produced to meet the consumers' needs.

Thus, turning the structure of equipment, in all its basic aspects, into a special object of planning and management; improving the methods and organization of estimating the demand for machinery and equipment; taking into account goals of optimizing the structure of the equipment pool in plans for the construction and technical retooling of enterprises; making significant

increases in the incentives for associations (or enterprises) for better utilization of means of labor; eliminating or significantly reducing the shortage of equipment--these are some of the basic directions in increasing the efficiency of the production system of the national economy.

9967
CSO: 1823/251

MECHANICAL ENGINEERING AT TALLINN INSTITUTE DISCUSSED

Tallinn SOVETSKAYA ESTONIYA in Russian 4 Apr 84 p 2

[Article by R. Linnas: "Feedback"]

[Text] Every 3 years the traditional Machine Builders' Day is held at Tallinn Polytechnical Institute (TPI). They meet at it to discuss problems of machine-building technology, prospects for developing metal-cutting machine tools and tools and present-day requirements for engineers. The most important thing at these meetings is the feedback of graduates, who today are already production managers and specialists, to the VUZ which started them in their career. For the institute this is an opportunity to adjust the training of new machine-building engineers and increase its effectiveness and quality.

Unlike previous years, now such meetings are held differentially--by specialties. This is fully proving its value. Lately, such a form has also been found such as discussion clubs, whose goal is to ascertain whether enterprises are satisfied with the specialists being supplied by TPI.

Late last year the regular Machine Builders' Day took place. In opening it, TPI pro-rector Professor B. Tamm stated: "The machine-builder's trade is considered to be the oldest, but mechanics can also take pride in the antiquity of their profession. Mechanics have been around as long as the wheel. This profession is always current, and now it is very important. Last year alone, 400 students were admitted to TPI for specialties related to machine building. The enrollment will be increased. Now the mechanics department of the institute is on the rise."

Later V. Rudenya, deputy director of the Dvigatel' Plant, and T. Tal'ving, chief engineer of the Tallinn Machine Building Plant imeni I. Lauristin, presented reports. The told of the technical progress and the increase in efficiency of machinery production at their enterprises. Academician I. Epik, vice president of the ESSR Academy of Sciences, (one of the department's first graduates) familiarized listeners with the problems of machine building in the republic and drew parallels with the overall level of machine building in the country and throughout individual republics. He suggested that the management of TPI make an analysis on how many graduates of the department become managers and how many become specialists in industry. Knowing this will do much for the future work of the department.

Docent R. Kyuttner, chief of the department of machine building technology, noted that during its 39 years of existence the department has given nearly 2,500 young people a start in life. This is a large and powerful army, whose labor has ensured the current level of the republic's industry, and we should be proud of our specialists. The department has available everything needed for such training. Here there are over 30 associates, many of them having academic degrees. A scientific research laboratory has been in operation under the department for 10 years, the staff of which includes 19 highly qualified specialists. The work of the department and the laboratory is known not only in our country, but abroad as well. Every year instructors and specialists participate in international conferences. The department has close scientific contacts with the country's major VUZ's and technical universities of Budapest and Dresden.

The material and technical base has been strengthened especially actively in recent years. Jointly with the "Algorithm", an automated training classroom for planning has been established in the department, where students master modern computer facilities. An industrial robot is also in operation here for practical exercises. Much other latest equipment has been obtained this year. The department also collaborates closely with the Plant imeni Kh. Pegel'man. The department is doing everything to popularize these enterprises among the students and to send its best graduates to work there.

Since 1982, training of machine-building engineers has been conducted according to new curriculums, oriented toward production automation and the use of modern computer facilities in machine and instrument building. However, enterprises, especially large ones, interested in the modern specialists must also maintain a link with TPI and send their grant-aided students here for training. In the GDR, for example, 40-60 percent of all technical specialties are made up of such students. There are years at TPI when there is not a single grant-aided student. The department and enterprises have all the resources for resolving joint problems of training specialists more efficiently.

TPI is the republic's only VUZ which trains designers for machine building. More precisely, they receive both process engineer and designer training, specializing finally in the process of diploma design preparation. Sixty percent of the diploma themes, assigned from future places of employment, are design themes. Defense of the theme is done before two commissions--design and manufacturing. Here the pluses and minuses of training are revealed. Whereas the students cope well with graphic, mechanical and design aspects, they are still not fully able to depict the machine as a single, structural and ergonomic entity, as well as from the standpoint of using modern control systems. It must be recognized that the future specialists are not able to use computer facilities. (The new curriculum is oriented in volume more toward manufacturing process training.) Furthermore, artistic engineering, or design, has been omitted altogether.

A problem of young designer personnel has cropped up. Linguistic training is also poor and there is a serious problem of collecting information on design novelties abroad.

Problems of machine tools with numerical control and industrial robots also require training of new personnel and improvement of their qualifications.

The appropriate public committee of the republic' Students' Scientific and Technical Society is helping engineers share experience and is organizing lectures, courses and conferences. A special club is being established, which leading specialists from each enterprise must join in order to be well informed about production robotization.

However, Lithuania, Latvia and Leningrad are far ahead of us in robotization. What is the reason for the lag? Apparently, here it is important to overcome the psychological barrier. The assistants must be the enterprises themselves who need specialists for the flexible systems.

Of course, now the leading engineers of enterprises are basically people of the older generation and their level of technical training sometimes does not meet the present-day requirements. We also must not discount the fact that the manager of an enterprise is taking a certain risk by introducing robots; the outlays are high and at first there is no return whatsoever. Enterprises must have great incentives here. The introduction of machine tools with numerical control and robots requires the cooperation of mechanical and electronics engineers. The introduction should begin with the more simple and reliable machine tools.

Presently, there is also a shortage of the necessary technical literature on this matter. As for popular science literature, a book "about robots", directed toward the schoolboy, must orient him to the real level existing in our country and not merely state the lofty world achievements. This will help attract the young person to a lively profession. It is obvious that the VUZ as well as enterprises must exert efforts here. Technical progress will not accelerate by itself.

Many of the tasks cited here will be fulfilled by the next Engineer-Machine Builders' Day. New ones will appear. The VUZ and its graduates will again solve them.

12567
CSO: 1823/261

MODERNIZATION OF UKRAINIAN MACHINE TOOL INDUSTRY REVIEWED

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84 pp 1-3

[Article by engineer K. V. Berezovskiy: "Ways for Increasing Labor Productivity in Machinebuilding"]

[Text] In the economic policy of the CPSU for the 1980's, emphasis is being placed on every possible intensification of production, which is inseparably linked with the mass utilization of new equipment and manufacturing methods and on this basis with an increase in the technical level of production.

It was noted at the 26th CPSU Congress that "if this formula is to be shifted to the language of practical matters, intensifying the economic system and increasing its efficiency consists first and foremost in the fact that the results of production grow more rapidly than the costs for it and that, while involving comparatively fewer resources in production, it's possible to achieve more."*

The 26th CPSU Congress set the task of leading all sectors of the national economy to the foremost gains of science and technology.

A number of important measures are being implemented in the current five-year plan for increasing the intensification of production. A leading place among them belongs to creating and assimilating the new and latest resource-saving equipment and manufacturing methods and to accelerating the retooling rates of sectors of the national economy and the full mechanization and automation of production.

During the five-year period in the industry of the Ukrainian SSR it is stipulated to assimilate over 4,600 new kinds of industrial production, to fully mechanize and automate 8,400 shops, sections and factories and to put in operation nearly 11,000 automated and mechanized flow lines.

Machine building is a key sector of the industry and the material base of scientific and technical progress in all links of public production. In the 11th Five-Year Plan the production output of the USSR's machine building must

* Materials of the 26th CPSU Congress, Moscow, 1981, p. 40.

increase by a factor of 1.4 (the growth rates of production of industrial output are 26 percent).

An increase in labor productivity is of paramount importance among the factors for raising the efficiency of public production. An increase of 18 percent in public labor productivity is stipulated in the current five-year plan as a whole according to the country's national economy. This is equivalent to a labor savings of 17 million people. By virtue of increasing labor productivity it is planned to obtain not less than a 90 percent increase in national income, and that is considerably more than was obtained by virtue of this factor in the 10th Five-Year Plan.

The assimilation of new equipment and manufacturing processes and the full mechanization and automation of production are an important condition for increasing labor productivity.

During the years of the 10th Five-Year Plan in the republic's industry, 300,000 people were shifted from manual to mechanized and automated labor as a result of mechanizing and automating production processes. And although a great deal was done, we are faced with doing far more. The relative share of manual labor costs in the national economy is still high. Thus, in spite of the fact that the number of workers performing automated and mechanized jobs is constantly growing, a considerable number of workers, and particularly in industry and construction, is engaged in manual labor (excluding repair operations) in the material production sectors. Therefore at the present time the problem of accelerating the rates of scientific and technical progress in every way possible and more actively utilizing its achievements, and first of all in sections where manual labor is still being used, is so urgent.

Experience in assimilating the achievements of scientific and technical progress in production was amassed by Kiev's enterprises. A review conducted in 1982 showed that the city's scientific and design organizations completed 9,800 scientific research subjects; the annual economic effect from incorporating operations completed during 2 years of the five-year plan into the country's national economy exceeded 919 million rubles.

The quota on introducing mechanized and automated production was completely met.

During 3 years of the 11th Five-Year Plan, labor productivity in the city's industry increased by 12.7 percent with a planned factor of 10 percent. By virtue of this, in 1983 a full increase in the volume of industrial production, including at the machine building enterprises, was obtained. Executing the tasks of the special-purpose over-all scientific and technical "manual labor" program facilitated this. The development and implementation of measures for mechanizing and automating production and for its reconstruction, which provide for reducing the use of manual labor and relieving heavy physical labor, are stipulated in it.

In the present Kiev program, subprograms were developed according to each sector of the national economy and according to each sector of industry, including machine building and metalworking.

According to the city's industry as a whole in accordance with the program in the current five-year plan, it is planned to incorporate 580 mechanized and fully mechanized and automated lines and to shift more than 16,000 people from manual to mechanized labor.

In 1983 alone 114 shops, sections and factories were fully mechanized and automated; 250 manipulators, robots and robot engineering complexes were incorporated; and up to 7,000 people were shifted from manual to mechanized labor.

Analysis shows that an almost 70 percent increase in labor productivity is provided on the basis of accelerating scientific and technical progress.

Considerable attention is being devoted by the machine building enterprises of Kiev's Zhovtnevyy Rayon to increasing the technical level of production. Thus, a large volume of operations for mechanizing and automating production processes and improving manufacturing methods was conducted at the Kiev plant imeni Lepse. A course is being pursued by the collective of the given enterprise towards creating designs of standard automatic loading devices and means for transporting components in connection with operating multipurpose and special equipment with the use of standardized units and mechanisms. There were 15 original designs of equipment and machine tools created here, and of which 5 are protected by copyright.

An increase in the technical level of production at the plant provides a considerable effect. Thus, the introduction of 29 automatic lines for machining pistons made it possible to sharply increase their output. At the present time the mechanization level of basic production processes at the plant is more than 88 percent and the coefficient of the technical production level is 0.79 percent.

In 1982 as a result of mechanizing and automating production processes at the plant imeni Lepse, 74 workers engaged in manual labor were released and an economic effect of 275,000 rubles was obtained. The plant became a pivotal base in incorporating an advanced foundry processing method among enterprises of the city and the entire sector.

In the current five-year plan on the basis of developments of the All Union Institute of Welding Production, six automatic lines were introduced at the Kiev Metal Products Plant imeni Pis'mennyy and that made it possible to completely automate the welding network's production at the given enterprise. In this case labor productivity more than doubled. Operations are being conducted as well by the institute on creating robotized complexes for welding, and the introduction of which will have a considerable influence on increasing production efficiency. A robotized welding section was created at the Kiev "Bol'shevik" plant and fully automated welding shops are being developed.

At the November, 1982 Plenum of the CPSU Central Committee the necessity was shown for not simply propagandizing the introduction of new equipment and new labor methods, but exposing and eliminating specific difficulties that impede scientific and technical progress. "As was noted at the plenum, a great

deal of organizational work is necessary not only in a cross-section of each sector, but also of each plant, each shop, section and, if you wish, each work place."*

The work experience of Kiev's leading machine building enterprises shows that the retooling of production of a new technical basis is an important condition for increasing labor productivity--the main factor of economic growth.

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* Materials of the CPSU Central Committee Plenum, 22 November 1982, Moscow: Politizdat, 1982, pp 11-12.

9889
CSO: 1823/233

SUPPLY, PRODUCTION PROBLEMS AT MOSCOW MACHINE TOOL PLANT

Moscow MATERIAL'NO-TEKHNICHESKOYE SNABZHENIYE in Russian No 3, Mar 84 pp 30-34

[Article by V. L'yanov: "Mutual Exacting Requirements and Responsibility--Meeting of the Moscow City Main Territorial Administration Workers With Machine Tool Builders"]

[Text] If one plotted on a map the diagram of connections of Moscow supplier enterprises with consumers, then the lines would merge with all rail, motor vehicle and water routes connecting the capital with the many cities of our motherland. And each of these economic arteries in one measure or another is controlled by the Moscow city main territorial administration and must pulsate in a smooth manner without jerks and malfunctions. This is why the workers of our system are devoting a great deal of attention to strengthening business contracts with supplier enterprises and consumers. Continuous contracts with the workers of industry allows them to be constantly informed about events, to see bottlenecks and, consequently, to reach necessary decisions in a practical manner.

Thousands of diverse enterprises, organizations and institutions are in the supply system of the Moscow city main territorial administration. It's natural that it isn't easy to "come to" each customer. But life urgently demands this.

The proverb says that the ocean is reflected in a drop of water. If it's true, then why wasn't it decided at the main territorial administration to try to study the problems confronting industry on the example of one or several enterprises. The "Moscow Machine Tool Building Plant" imeni Sergo Ordzhonikidze became the object for this kind of analysis.

It's necessary to say that formerly there was no experience for comprehensively examining matters of material and technical supply of a specific enterprise. A large group of specialists of the main administration and the association has conducted a complex analytical study. There was a great deal of misgivings as to whether it would succeed in directing the well-conceived conversation towards the channel of constructive discussion of the problems. Won't the meeting end up in a mutual exchange of complaints? While getting ahead of myself, let's say, this didn't occur.

In order to understand the essence of the matters that were discussed at the conference it's necessary, even if in a general way, to talk about the production association of the "Moscow Machine Tool Building Plant" imeni Sergo Ordzhonikidze. It consists of a head enterprise and a number of plants in Moscow and other cities that are turning out special purpose products: high-precision automatic machines, machine tools with computer numerical control, and automatic lines. Basically, they're being delivered to enterprises of the automotive and tractor industry.

The association is manufacturing a series of machine tools and individual machine units in accordance with special orders. It's important to note that even in the process of manufacturing a series production each subsequent machine tool is being improved and modernized. There are very rare instances when two identical machine units are produced, even in the same series. Thanks to the constant searching of the designers, the Muscovites are taking an appreciable step forward from machine tool to machine tool. And this allows their items to compete successfully with the products of the most distinguished foreign firms.

One's attention has to be directed to the specific nature of the work of designers, engineers and inventors because this bears a direct relation to the problem of providing the association with material resources. The improvement of products is impossible without utilizing the latest achievements of science and technology. At the plant they are closely watching the novelties that are occurring in the laboratories of the scientific and design bureaus. They are endeavoring here to utilize all resources for equipping the next machine tool or automated line with the latest and most precise instruments.

The association's collective of many thousands is doing everything in order to successfully resolve the tasks set before it. Year after year it is coping with complex production quotas in a stable manner and it is fulfilling its contracts 100 per cent for deliveries of products to customers.

While unanimously approving the decisions of the December, 1983 Plenum of the CPSU Central Committee, the collective of machine tool builders accepted a counterplan for this year by which it is stipulated to manufacture an additional half a million rubles of output, to achieve an increase in labor productivity of 1.6 percent over and above the plan, and to reduce production cost by an additional 0.75 percent. A great deal of attention is being devoted to increasing the quality of the products. It is specified to produce three-fourths of all machine tools with the state emblem of quality.

The advances, which the association is faced with taking, can be achieved only as a result of great effort. A great deal here depends on providing production with material and technical resources, and especially with complete items. In fact, today in connection with the vast utilization of standardized modules, automatic manipulators and microprocessing equipment, the timely delivery of necessary components is particularly important.

While opening the conference of the active membership of machine tool builders and supply workers, the association's general director N. S. Chikirev expressed satisfaction with how mutual relations are developing with the Moscow city main

territorial administration and its subunits [podrazdeleniye]. There was never an occasion when an enterprise found itself on the verge of disrupting the plan because of shortcomings in providing material and technical resources. The contract that was concluded with the main administration, and which is being absolutely fulfilled, facilitates the successful work of the production workers.

One must agree that there is a considerable difference in transient contacts, when workers of the enterprises and the main administration resolve particular matters connected with obtaining items of one kind or another, and with a profoundly thorough conversation of this kind that took place at the plant. Many serious problems, which are difficult to settle in an ordinary working situation, were touched upon in the process of dialogue. And they appeared in a most serious light when submitted for discussion by high ranking managers. One could not but respond to the matters which were set and pass them over in silence. A great deal of mutual complaints were heard in the speeches of the conference participants. But it is gratifying to state: both parties didn't try to justify their unfinished work, but demonstrated a desire to find ways for averting it in the future.

N. V. Potekhin, deputy chief of the main territorial administration, also noted that as a whole our mutual relations with the machine tool builders are developing well. The enterprise is doing a great deal for improving operations on economizing and utilizing material and technical resources in an efficient manner, reducing material consumption, and strengthening delivery discipline. In turn, the main administration is making great efforts for a smooth and timely delivery to the enterprise of materials and complete items on the products list of USSR Gossnab. Questions on providing the association's production plans are being examined twice a year in all organizations and specialized administrations that supply the plant. If it happens that individual differences aren't reconciled in a successful manner, they are submitted for discussion by the main territorial administration.

Last year the machine tool builders received three-fourths of the total amount of their allotted metal. Apparently it was enough since requests weren't received for delivery of the unselected portion of resources. The plant is receiving 80 percent of the metal from enterprises in accordance with deliveries of the main territorial administration. A situation of this kind is explained by the absence of direct and lasting economic contacts with the metallurgical plants.

Why did such a situation arise? Who's guilty in this case? No, the machine tool builders aren't advancing any arguments against a progressive form of mutual relations with suppliers. At the present time the entire matter is in the existing system of through-shipment deliveries, when it's essential that there may be no less than 12 norms according to sort and grade size. Such rigid conditions proved to be unacceptable for the machine tool plant because of the particular distinguishing features of its production. Inasmuch as other clients are also in a similar situation, USSR Gossnab gave instructions to the main supply and marketing administration to prepare a proposal for reducing the current through-shipment norms. The new situation is creating good conditions for setting up direct sustained economic contacts with suppliers and the machine tool builders intend to avail themselves of this opportunity.

The lion's share of metal is coming in from the enterprises in accordance with deliveries. We believe the USSR Gossnab representatives announced that rolled metal is being used for fulfilling the production quota. How can the practice which arose in a case of this kind be explained when "delivery by demand" figures in all the plant's orders? How much does this conform to the current production cycle at the enterprise?

If one speaks only about the quantity of metal being allotted, then it's enough the machine tool builders explained. However the specific nature of production is such that planning delivery uniformly by quarters of the year doesn't correspond to the actual consumption of metal. The production of items is determined by the nature of the orders. For example, the manufacturing of a particularly precise, standardized machine unit doesn't always lead to an increase in metal consumption. And the other way around. Thus the demand for other materials and complete items also "fluctuates."

Workers of the main administration directed the attention of the plant's management to difficulties which wouldn't have occurred if the enterprise would have had closer contacts with the USSR Gossnab organs. For example, last year interruptions occurred in the electrical wire supply through the fault of the plants and manufacturers. Inasmuch as this also has occurred before, it would be advisable to appeal for assistance to the main territorial administration which would try to come to the aid of the machine tool builders during a difficult moment.

From the remarks which were heard in the hall it was ascertained that the plant asked to be allotted a small quantity of electrical wire. But how? A telephone conversation between two workers took place. A representative of the main territorial administration explained that he doesn't have a right to resolve this matter on his own and, having stated the request in written form, it's necessary to bring it up at a higher level. However, the plant didn't show persistence. And in the end a not so complicated problem remained unresolved.

Inasmuch as others who spoke also cited examples when they weren't successful in obtaining even noncritical items within the operating procedure, the managers of the main administration promised to simplify the procedure for allocating them, as well as to expand the products list of production being delivered to the enterprise. They assured us that in necessary cases they will show greater initiatives in issuing material resources to the plant on credit.

Those who spoke proved the advisability of such a step in specific numbers and facts. They reminded us that last year the plan for deliveries of direct coupling electrical installation wire to machine tool builders was fulfilled by only 76 percent. Difficulties arose not only because of stoppages in supplying materials and items. A change of suppliers, which in no way was well-founded, seriously hindered matters. For a long time the plant was attached to one of the Moscow enterprises that provided the machine tool builders with electrical wire. The neighbors had good business contacts and no problems whatever arose.

But last year, having not even coordinated its decisions with the plant and the main territorial administration, the Main Administration for Cable unexpectedly attached the enterprise to a new supplier. Both parties were already on the point of setting up contacts with each other and they contemplated the prospects of joint cooperation. However, the Main Administration for Cable next changed the supplier. Now the machine tool builders will obtain production from Lithuania. It is doubtful whether such a decision contributes to the benefit of the matter.

A breach of contacts which were established between suppliers and clients causes many difficulties which are not visible from elsewhere. The solution of problems for realizing funds in a timely manner and increasing the quality of products, and for selecting the most convenient and profitable method of shipment, becomes complicated. It's necessary to add to this that one has to coordinate all over again such aspects as payment, the return of packing materials, and others.

Workers of the main territorial administration agreed with the fact that many arguments of the machine tool builders are serious and well-founded. The conference participants came to the over-all conclusion: the way of resolving a majority of the problems is in establishing and developing direct, sustained economic contacts and in providing for their stability.

One of today's basic demands is accelerating scientific and technical progress. While fulfilling it, the plant's workers are constantly improving manufacturing methods, equipment and machine tools. Therefore all parameters of the equipment being used must be in keeping in line with the high class of machine units and automatic lines. And very much here depends on the delivery of complete items. For the time being they're not always satisfying the machine tool builders.

The plant's representatives emphasized that the question isn't about the conformance to required parameters and quality of the equipment and instruments being received. Complete items, and even the highest precision and most reliable in operation, can't always be used on the machine tools being produced by the enterprise. There are dozens of varieties of instruments that are identical in designation, but which are distinguished from each other by individual technical nuances. The machine tool builders emphasized that the mistakes, which recently have become more frequent, of the employees of the specialized administrations that complete the items worry us. Skilled specialists, who know very well the matter entrusted to them, must perform this work. It's necessary for them to continually increase their occupational and technical level.

A particular conversation at the conference concerned more resolutely waging the struggle for economizing and utilizing material resources in an efficient manner. In the final analysis, consideration for them is both an opportunity for producing a larger quantity of items without a considerable increase in the expenditure of materials and a realistic way for reducing the metal content of the products. A great deal is being done at the enterprise in this direction. Paramount attention is being devoted to reducing the expenditure norms of resources, and especially of ferrous rolled metal.

At the same time, the machine tool builders also have considerable reserves for economizing. First of all, they should raise the coefficient for metal utilization which is 0.14 below the mean sector coefficient. It's necessary to eliminate infractions of the rules for storage of the products. For example, sheet metal and cold-drawn steel are now being stored in an open area, a weighing setup is absent, and the premises of the metals warehouse aren't enclosed.

There are also many shortcomings in the utilization of fuel and energy resources. The organizational and technical measures plan for economizing them isn't completely providing for fulfillment of the tasks. Fuel and thermal energy balances, as well as the energy balances of resources for individual factories, aren't being compiled. Meanwhile, it's difficult to provide for the conditions of thrift without an accounting of their expenditure by each shop and by each machine unit.

Both sides didn't conceal a preoccupation with the presence of large above-norm reserves that aren't credited by the bank and of materials that aren't being utilized. They are accumulating at the enterprise through the fault of the plant's workers, but, as the speakers unanimously noted, the USSR Gossnab organs also must strive for reducing them. Last year the machine tool builders submitted more than half of the entire quantity of above-norm reserves to the main territorial administration for sale. However, the department for the mobilization of material reserves didn't make the proper efforts to redistribute these assets and limited itself to including them in informational lists. As a result, less than a tenth of the materials were sold.

Plant managers called the problem of exchanging metal products among enterprises urgent. Now and then life itself forces one to quickly find the necessary materials. And although the nonutilized material and technical resources are drawn into national economic circulation and their turnover rate is accelerated in such instances, it isn't easy to perform an exchange of this kind. It's necessary to make a reservation at once that it isn't a question of some kind of illegal operations, but of those that were allowed as a matter of principle.

Having set about manufacturing special purpose equipment, the machine tool builders discovered that there wasn't one of the kinds of metal products. A very few minutes were needed to clear it up: a neighbor--the "Krasnyy Proletariy" production association--has a surplus of it. It agreed to deliver this product. The main territorial administration also didn't object. But how much time was spent on filling out the documents and collecting the various signatures. And meanwhile production stood idle for an entire week.

A great deal of time is lost not only on the unnecessary creation of paperwork, various coordinations and collections of signatures. Recently at some enterprises for product deliveries those arriving to receive items are standing idle in line for hours. Isn't it possible to avoid this? Absolutely. At the conference they named the enterprise for product deliveries in Karacharov and the "Elektropribor" ["Electrical Instrument"] store where one doesn't have to lose costly time. So everything depends on a state of being well organized and a responsible attitude of people towards their duties.

The machine tool builders directed their attention to the large quantity of every possible kind of reports and to the compilation of which highly skilled specialists are torn away from their work. If an enterprise is working normally, producing output on the prescribed products list, and fulfilling its contracts, is it necessary to submit a great number of reports to the USSR Gossnab organs? It's another matter if the plan is ruined because of the late delivery of metal or complete items.

One of the most acute problems that bothers not only the machine tool builders, but also the workers of the other metropolitan enterprises is the shortage of acetylene. In many of the plant's sections there are large work stoppages because of this. For the time being there are no hopes, the specialists lamented, that they will manage to solve this problem in the near term. As far back as 15 or 20 years ago ZIL [Automotive Plant imeni Likhachev], at which appropriate capacities were created, provided Moscow industry with acetylene. However, the demand for acetylene has grown considerably in connection with the increase in production of motor vehicles. Now the motor vehicle plant hardly has enough of it for covering its own needs.

The acetylene problem occurred because there isn't a department that would be responsible for producing and supplying enterprises with it. The machine tool builders asked that this matter be placed before the appropriate organizations. They assured them that they are ready to take a fractional part in creating capacities for producing acetylene and to render technical assistance in the building of the appropriate enterprise. A proposal was made that the enterprise for deliveries of chemical products of the main territorial administration supply the capital's industry with acetylene. The creation of an appropriate services shop would provide the necessary utilization of people and equipment, and then it would prove to be a profitable matter. For its part the plant expressed willingness to set up the necessary equipment and to meet the costs of creating new production.

A great deal was said at the conference concerning the return of packing materials--the necessity to use them over and over and to treat them with care so that they will serve for a longer time. But packing materials differ. Frequently they cause many more troubles than they deserve. The question concerns petty, in the literal sense of the word, "cheap" containers which it is necessary to return to the plant and manufacturer of chemical products. The enterprise uses a comparatively small quantity of lacquers and paints, but they come in from the most diverse areas of the country. The return of packing materials to the product manufacturer isn't simply additional troubles. The railroad doesn't accept small lots of flasks and containers for shipment. In addition, it's necessary to return the packing materials free from the residues of paint and lacquer products. And for this it's necessary to create a specialized factory with the proper equipment. Of course, this business is extremely unprofitable and unsuitable.

The conference participants spoke with particular concern about providing for the needs of the enterprise with lumber in an unsatisfactory manner that gives rise to "expediting" and other negative occurrences. The plant's workers made an interesting proposal with regard for the circumstances and a real evaluation

of the situation that was created. Under the conditions of a scarcity of lumber, and in order to stimulate the enterprise towards a more economical and efficient consumption of it, it's better to reduce funds than to draw a warrant for unreceived goods and services and thereby doom the consumers to unrealizable expectations. When enterprises know precisely what quantity of materials they will receive, then they will be able to maneuver better with the available reserves and to find additional resources and substitutes.

Many other problems also were raised at the conference. Certain ones of them have already been resolved and others are being studied. The territorial organ reported on three of them to USSR Gossnab and other departments. Having stipulated further improvement of economic relations, and with regard for the new tasks that confront the enterprise and the main territorial administration, both parties made corrective amendments to the contract for organizing material and technical supply. Mosgormashsnabsbyt [Moscow City Machinery Supply and Marketing Administration], Mosgorelektrosnabsbyt [Moscow City Electrotechnical Supply and Marketing Administration], Mosgorkhimsnabsbyt [Moscow City Chemical Supply and Marketing Administration], and Mosgorsnabsbyt [Moscow City Supply and Marketing Administration] will be taking a more active part in providing the enterprise with resources. The machine tool builders transferred a portion of their own funds to them in order to create the necessary reserves of material and technical resources at the enterprises for deliveries. This will allow the enterprise to obtain the necessary items in a practical manner in the event of a short delivery by through shipment.

The parties coordinated the basic questions associated with expanding the volume of deliveries via direct, sustained economic connections. Specialized subunits of the main territorial administration developed additional measures aimed at providing for the centralized delivery of products on the basis of coordinated schedules. The wishes of the machine tool builders were heeded and the practice that existed formerly was revived for the sale of noncritical products under the system of wholesale trade without quotas and by quotas.

Measures were taken as well that will allow more efficient utilization of material resources. The preparation of documentation was regulated and the filling out of forms was simplified for the allocation of additional material resources to consumers in accordance with the products list being distributed by the main territorial administration.

While planning the supply of the production association for the current year, the main territorial administration took into consideration the remarks and suggestions of the machine tool builders. This made it possible to achieve the best coordination of production plans with the allocation of material resources in the full amount and required products list. Measures were stipulated for reducing above-norm reserves and for drawing unused assets into economic circulation.

The experience of conducting a meeting with the machine tool builders and a profound analysis of the formulated problems revealed new and considerable reserves for improving the supply of industrial enterprises with material and

technical resources. Joint discussion of the most important problems confronting the enterprise and the supply organ enriched them and it facilitates overcoming bottlenecks and strengthening the mutual confidence and responsibilities of the parties.

We have managed to solve many of the problems that were spoken about during the meeting and this has led to an improvement in the operation of the enterprise. The elimination of obstacles that hamper the enterprise in obtaining the material resources it needs in a timely manner has an appreciable effect on the smoothness of operations. That's why the main territorial administration decided to conduct meetings of this kind on a permanent basis and to convert them to traditional ones.

The second meeting took place at the production association "Moskovskiy Elektromekhanicheskiy Zavod" ["Moscow Electromechanical Plant"] imeni Vladimir Il'ich. The meeting was of particular importance for both sides, and in fact the association is one of the many enterprises of Minelektrotekhprom [Ministry of the Electrical Equipment Industry] that is participating in the economic experiment. This also determined the nature and the substance of the matters discussed.

The association director A. A. Degtyarev and others who spoke in detail analyzed the situation that occurred last year with fulfillment of the plan in putting delivery contracts into effect. The production program was provided with much labor. Of course, there were many reasons, but the basic one was shortcomings in providing material and technical resources. The association's head plant didn't work in a smooth manner because of the incomplete and late allocation of funds by Minelektrotekhprom for ferrous rolled metal. As a result there was a considerable shortfall of electric motors and washing machines for consumers.

Tension in the operation of the enterprise was explained partly through the fault of subcontractors who constantly violated the contracts. But the main territorial administration also delayed deliveries of ferrous and nonferrous rolled metal, cable items, lumber and other products. Because of inefficient organization in delivering materials in a centralized procedure, the association had to haul them with their own transportation. In addition, it wasn't just from enterprises located in Moscow, but it also was for many hundreds of kilometers from the capital.

A. S. Udachin, first deputy chief of the Moscow city main territorial administration, analyzed the shortcomings in the association's activities. He took notice of the fact that the association continually overstates its requirements for resources. Therefore, a large quantity of above-norm reserves and unused materials are accumulating at the enterprise. While analyzing the indicators for fulfilling contracts, he paid particular attention to shortcomings according to the most important controlling trends--the agroindustrial complex and enterprises that are fulfilling the energy program.

Last year the enterprise made use of the maximum percentage of underfulfillment established for it. However, as the December, 1983 Plenum of the CPSU Central Committee pointed out, in the future one cannot rely upon this stipulation. It's

necessary to completely close a "loophole" of this sort. The enterprise should provide for 100 percent fulfillment of contracts.

A. N. Lebed', deputy chairman of USSR Gossnab, and A. N. Alov, chief of the Moscow city main territorial administration, spoke before the meeting's participants.

9889
CSO: 1823/241

HIGHLIGHTS OF MOSCOW MACHINE TOOL EXHIBITION

Moscow EKONOMICHESKAYA GAZETA in Russian No 15, Apr 84 p 23

[M. Makhlin report: "'Metalloobrabotka-84'"]

[Text] The staging of this major international exhibition of equipment, tools and instruments for the metalworking industry occupies the territory of two exhibition complexes in the capital, at Krasnaya Presna and in the Sokolniki, a total of 26,000 square meters. From 27 March through 5 April organizations and firms from Austria, Belgium, Bulgaria, Great Britain, Hungary, the GDR, the FRG, Spain, Italy, Luxembourg, the Netherlands, Norway, Poland, Romania, the United States, Finland, France, Czechoslovakia, Sweden, Switzerland, Yugoslavia and Japan, and also West Berlin, are showing their innovations at the "Metalloobrabotka-84" exhibition.

The most respresentative stand is the Soviet Union's. Some 300 exhibits in our section demonstrate convincingly the diversity of export possibilities for Soviet-produced machine tools and their high technical level.

There is special interest in the so-called machining modules--the production cells from which the flexible production systems are made up. It is precisely these kinds of lines and individual NC machine tools with automatic replacement of tools and parts that occupy a dominant place in our pavilion.

One noteworthy feature of the exhibition is the abundance of industrial robots. Since the beginning of the five-year plan the size of the inventory of industrial robots has almost trebled in our country. The new technologies are becoming increasingly involved in the mechanical machining of parts. Many exhibits in the Soviet section are associated with electrophysicochemical methods. Our country's share in world production of this kind of equipment has now topped 40 percent.

All the European CEMA countries and Yugoslavia are taking an active part in the exhibition. The Soviet section and their stands literally complement each other and they graphically illustrate the advantages of socialist economic integration. Agreements on international specialization and production cooperation in the production of machine tools cover about 800 designated articles, from automatic lines to technological equipment. In Bulgaria, Poland, Romania and Czechoslovakia, for example, they have organized the production of complete sets of electric feed drives with high-moment motors for all the CEMA member countries.

The largest exhibits from the capitalist countries are those of the FRG firms (more than 8,000 square meters of fllor space) and Italy (2,300 square meters).

The enterprises of the Ministry of the Machine Tool and Tool Building Industry maintain production cooperation with 16 West European firms. The possiblity of dealing with another 20 partners from the capitalist countries is being considered. Thus, at the request of clients, Soviet metal-cutting tools are being equipped with programmed control systems from the West German firms Siemens and Bosch, Italy's Olivetti, Japan's Fanuk, and Sweden's ASEA and SAAB. In turn, Soviet equipment is being used to make up sets of export products for foreign partners. Many of them took part in the exhibition.

Photo Captions

Flexible Production Systems.

The future of machine tool building production is rightly linked to the kinds of flexible systems such as the PAS MA-1 (in photograph) being demonstrated in the Soviet section. The PAS MA-1 is an automatic line for an extensive product range, with replaceable multispindle feed boxes designed for machining openings (drilling, countersinking, reaming, chamfering, turning internal threads) in body parts from four designations and seven standard sizes, and is used as part of a set, for two kinds of compressors.

Productivity is 4,800 sets annually with an efficiency coefficient of 0.8. Feeding and removal of parts does not require stopping of the main process. Control of all mechanisms is done with the aid of a programmed controller. Adjustments to operating modes are made from a central point. Two people work on the line, namely an operator and a setter-up.

Laser Technology.

The Moscow ENIMS Scientific Production Association showed a light-beam installation (in photograph) at the exhibition. An NC system controls a bench, mechanisms, and the operation of an optical quantum generator. A laser device with an energy of up to 2 joules machines openings in electrodes for gas-discharge instruments and aviation parts, cuts apertures and slots of any shape in ceramic plates for microelectronics, and shapes many-sided instruments made from superhard materials.

9642
CSO: 1823/265

DEBATE ON NATIONAL FMS PROGRAM URGES CAUTION, ROI

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Jan 84 p 2

[Report on interview with Prof P. Belyanin, director of the Technology and Organization of Production Scientific Research Institute and doctor of technical sciences, by D. Pipko, editor of SOTSIALISTICHESKAYA INDUSTRIYA for science and technical progress, in the column "Carry Out the Decisions of the December Plenum": "Flexible Manufacturing Systems"; passages rendered in all capital letters printed in boldface in source]

> [Text] FMS. This combination of letters is being heard more often at meetings and scientific conferences and in talks by scientists, technologists, designers and party and economic supervisors. Hopes for a considerable increase of labor productivity and for raising work efficiency of many enterprises are linked with it. In order to accelerate the development and introduction of FMS--flexible manufacturing systems--the resolution of the CPSU Central Committee and the USSR Council of Ministers "On Measures for Accelerating Scientific and Technical Progress in the National Economy" recognizes the necessity of combining all work within the framework of all-union programs.
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> This means that for many enterprises and even sectors the transition to flexible technology will become the primary direction of technical progress in the years immediately ahead and will require efforts of thousands of specialists. In order to avoid miscalculations and failures, it is necessary to have a clear notion of the type of potential advantages that are laid in the idea of flexible manufacturing systems and the means for using these advantages so that they would yield a maximum return. It is precisely these questions that opened the discussion between D. Pipko, editor of SOTSIALISTICHESKAYA INDUSTRIYA for science and technical progress, and Prof P. Belyanin, director of the Technology and Organization of Production Scientific Research Institute and doctor of technical sciences.

Freedom of Maneuver

[Answer] "I would like to stress right away," the scientist said, "that so far no one in the world has been able to develop FMS in the full meaning of

this concept. Even the much talked about automated robots plant of the Japanese firm Fujitsu Fanuc is nothing more than a test of strength on the way to flexible systems. I am saying this because far from everyone has an idea of the task's real complexity and of the need to abandon the parochial approach for the sake of common interests. There are also symptoms which indicate that in some places the solution of this task is being approached from positions of the moment: some enterprises undertake the development of flexible systems without having a scientific reserve, personnel and a technical base.

"Meanwhile, we have real possibilities for consistent, stage-by-stage development of highly efficient flexible systems. Conditions for this were prepared by party and government decisions, in accordance with which the output of machine tools and machines with numerical control (ChPU), industrial robots and manipulators and microprocessing equipment has sharply increased in the past few years. Experience has also been accumulated in industrial operation of a sort of component parts of future FMS--flexible complexes of machine tools and machines which operate in coordination according to a unified program. The ability of changing rapidly to manufacturing new articles is usually called as their main advantage. THE IDEA OF FMS CONSISTS IN ORGANICALLY COMBINING THE ADVANTAGES OF FLEXIBILE TECHNOLOGY AND COMPREHENSIVE AUTOMATION, AND NOT ONLY PREPARING THE SYSTEM FOR SOLVING NEW TASKS ON THIS BASIS BUT ALSO FOR ELIMINATING THE "BOTTLENECKS" WHICH AFFECT ITS EFFICIENCY.

"The main one of these tasks is generally known: in order for the national economy to develop dynamically, the industry must supply it with absolutely perfect machines, equipment, devices and materials. For this purpose the latest achievements in science and technology must be mastered much more efficiently than they are today. From these positions the FLEXIBILITY OF TECHNOLOGY IS ONE OF THE DECISIVE MEANS MAKING IT POSSIBLE TO ENSURE A HIGH LEVEL OF MANUFACTURED PRODUCTION THROUGH ITS TIMELY RENOVATION."

[Question] "Petr Nikolayevich, does it not seem to you that by pinning hopes on the flexibility of future systems we sort of relieve ourselves of the responsibility for conservatism, today's fine wires to introduction of new equipment. After all, the need for renovating production arises far from every day..."

[Answer] "If the difficulties of introduction were caused only by conservatism and sluggishness of people responsible for it, we would have found a way of keeping them in check. Economic levers will not solve the problem if possibilities for a maneuver are not laid in the technology of equipping the system. Especially since a certain flexibility is needed by enterprises in a literally sense every day. In grasping the spirit of the time, consumers more often refuse to accept the appearance on the market of large batches of identical goods. Customers placing orders for machines and equipment, being concerned about the efficienty of their systems, compel a manufacturer to provide series articles with special qualities assigned by them.

"Under the pressure of these demands, the Western firms, for example, were forced to reorganize production which made it possible for them to assemble

passenger cars with different trimming, equipment and comfort systems on a single conveyer. In this attempt to 'entice' the customer there is also a rational grain. Let us take trucks as an example. The possibility of making 'corrections' directly on a conveyer as regards employment conditions--rural area, city, desert, tundra--can provide consumers with a significant effect. Consequently, the FLEXIBILITY OF TECHNOLOGY IS ALSO NECESSARY FOR THE PURPOSE OF DRAWING THE PARAMETERS OF PRODUCTION CLOSER TO THE NEEDS AND REQUIREMENTS OF VARIOUS CONSUMERS.

"If one looks from these positions at contemporary machine building, then one will be compelled to admit that its technology and equipping of shops are poorly adapted for a painless transition to production of new or modified products. We have grown accustomed to cite the great expenditures that are needed for this. Although it would be more correct to speak of losses.

"When it is necessary to master a fundamentally new article, it turns out quite often that a considerable part of the fixed capital of an enterprise--equipment, tooling and instruments--is not suitable for its output and needs replacement. Even if this equipment has completely paid for itself, but retains its work ability and is sufficiently productive, abandoning it is equivalent to losses of the labor, energy and materials invested earlier. They are the ones which have to compensated for by great expenditures for retooling, modernization and sometimes for construction of new shops. BUT FLEXIBLE TECHNOLOGY MAKES IT POSSIBLE TO PRESERVE THE BASIC CAPITAL TO THE MAXIMUM AND TO REDUCE TO A MINIMUM THE LOSSES AND EXPENDITURES IN MASTERING NEW PRODUCTS."

Problems and Reserves

[Question] "The question about production requiring high flexibility was raised on the pages of SOTSIALISTICHESKAYA INDUSTRIYA back in 1972 in an article by Academician B. Petrov and Prof A. Bulgakov 'Programmed Systems.' It specifically raised the question about group utilization of machine tools with computer numerical control, united by control from one electronic computer and a system for conveying components from one machine tool to another. But the technological flexibility achieved in doing this was regarded basically as a means of raising the productivity of the equipment."

[Answer] "This problem retains its relevance also today. In small-series production, whose share accounts for 75-80 percent of all machine building production, the workload ratio of machine tools with numerical control equals on an average to 0.4-0.6. The shift coefficient at most enterprises does not exceed 1.3-1.6. If in addition to all of this the stoppages for routine maintenance, repairs and similar operations are taken into account, then it will turn out that machine tools produce goods only during 600-900 hours out of the annual budgeted time of 8,750 hours. In other words, their potential possibilities are used only 7-10 percent.

"There are huge reserves behind these statistics. 'We should also revive the movement for raising the machine operation shift coefficienct..,' was stressed in the text of the address by Comrade Yu. V. Andropov at the December (1983) plenum of the CPSU Central Committee. 'It is unlikely that proof is needed to show that by this means it is possible to substantially increase the output of

good and reduce expenditures for production.' IF WE COULD SWITCH ENTERPRISES TO A THREE-SHIFT OPERATION, THEN WE COULD GET 1.5-2 FOLD MORE PRODUCTION BY USING THE SAME EQUIPMENT AND WITH THE SAME FIXED CAPITAL.

"But the number of people who consent to work at night has been declining every day. Neither pay increases nor other benefits are of any help. In order to seize this reserve it is necessary to ensure round-the-clock operation of equipment in an automatic regime.

"In speaking about advantages of machine tools with numerical control we usually lay stress on the ease with hich it is reset to processing new articles--for this it is sufficient to change a punched tape with a recorded program. But numerical control systems have another important advantage: they make it possible to set programs of great complexity, including basic as well as auxiliary operations in them. Machine tools of the 'machining center' type were developed on this basis, whose main feature is a magazine with an extensive collection of different cutting tools. Any of them is automatically extracted from the magazine according to a program and placed into operation. By doing this one 'machining center' can fulfill the 'responsibilities' of several machine tools: placed on the working table, a part can be subjected to the most varied machining operations.

"In this case, a worker's actions are basically reduced to mounting an unfinished work piece on a machine tool and removing it after it has been machined. Industrial robots can fully handle such operations with most components. The largest base components can be secured on 'satellites'--special platforms which with the aid of a conveyer are automatically delivered to the work table of a machine and aligned in their proper position. If several 'satellites' with unfinished work pieces are stored on a conveyer, then a machine tool can operate round the clock without participation by man."

[Question] "But what is the connection between this technical solution and the idea of flexible systems?"

[Answer] "The most direct. By loading the magazine of such a machine tool with the necessary cutting tools, 'satellites' with unfinished work pieces of various components can be installed on a conveyer. High technological flexibility can be achieved in this manner. To be sure, for this purpose it is necessary to have computer numerical control systems that can store in memory and automatically select from whole 'libraries' of control programs. But modern microprocess are quite capable of handling this task.

"MACHINE TOOLS AND CNC MACHINES WITH AUTOMATED TOOL CHANGING CAPABILITY, AUTOMATED PARTS DELIVERY AND OTHER SYSTEMS THAT ENSURE 'UNMANNED' MANUFACTURE OF VARIOUS ARTICLES, AND THE ABILITY TO OPERATE FOR LONG PERIODS OF TIME, ARE CALLED FLEXIBLE MACHINING MODULES (GTM). Such modules can be developed not only for metalworking but also for foundry, press and forge, galvanic and other shops. They can be regarded as component elements from which flexible technological complexes will be put together."

[Question] "Judging by the statement in the press by Minister B. Bal'mont, specialists of the Ministry of the Machine Tool and Tool Building Industry intend to proceed precisely along the path of extensive production of various modules. They do not exclude their utilization as independent units. Will we not encounter here the same problems as during the introduction of machine tools with numerical control and industrial robots? It is unlikely that the appearance of one module in a shop will noticeably increase the flexibility of technology. It cannot be left to work at night without control. At least an electrician, an adjuster and perhaps other specialists will be needed."

[Answer] "Intermediate stages cannot be avoided in any new undertaking. In the example of machine tools with numerical control and, later, robots, we were soon convinced that they produce the greatest effect if used in large groups. This conclusion is also correct as regards flexible modules. Therefore, the basic strategy of their introduction will be connected with unification in flexible complexes. All the more so because by themselves--outside the complexes--the modules do not solve the maximal equipment utilization problem."

The Road to Complexes

[Question] "One of the characteristic tendencies of modern equipment consists in continuous complication of articles, their components and unit. For example, some components, in order to attain their final appearance, must undergo processing on 50-70 universal machine tools or in several 'machining centers.' A question arises unavoidably in such situations: what is the best way of scheduling the operation of the machine tools?"

[Answer] "When the question is about one component, then even a novice technician is in a position to solve it. But in speaking of flexibility of production, we mean that most varied components will be processed in a single flow. Moreover, such a system must be ready to switch to production of new articles at any moment. In other words, with the appearance of every new component the question of equipment workload must be solved all over again, and quickly. And in so doing, a way must be sought for the most advantageous, optimal solutions. Hence the idea of controlling a group of flexible modules or machine tools by one electronic computer. Such UNIFIED CONTROL FROM AN ELECTRONIC COMPUTER ENSURES THE FIRST LEVEL OF EQUIPMENT INTEGRATION, ALLOWING MAXIMAL UTILIZATION OF CAPABILITIES OF A GROUP OF MACHINE TOOLS THROUGH OPTIMAL SCHEDULING AND WORK SYNCHRONIZATION.

"Admittedly, another problem arises here immediately: how to ensure the transfer of a component from one machine tool to another? A tempting idea, on the face of it, is to line them up on the conveyer and get something resembling a traditional automatic line.--This does not hold water. The processing time on every machine tool is different. Therefore, the rate of a conveyer will be restrained by the 'most slow-moving' of them. But the main complexity is that any new component may require transfer from one machine tool to another in a different sequence."

[Question] "As far as I know, the developers of some flexible complexes here as well as abroad have limited themselves to leaving transportation operations with workers by equipping them with the necessary means--for example, battery trucks."

[Answer] "During the first stage such a solution should not be disregarded. Especially if a complex consists of two-three machine tools and a component is processed on each one of them long enough. But a flexible automated transportation system (ATS) provides a radical solution of the problem. The principle 'return to place' can be used as its basis. Its sense is in the fact that transportation threads from all machine tools meet at the warehouse of unfinished work pieces and components, which plays the role of a kind of a 'junction.' Unfinished work pieces are directed to machine tools from their cells, for example, with the aid of automatic trucks--robotized cars--and returned back to the same place after processing. As a result, a component can be sent through such a warehouse--with pauses or without them--from every machine tool to any other machine tool of the complex.

"For comparison here we can recall the ordinary automatic lines where components are shifted from unit to unit strictly in one direction. It is impossible to direct a component 'against the flow' here in order to use any of them a second time. Therefore, if a component, for example, has to undergo three drilling operations and they cannot be combined, then three drilling units must be built into the line. BUT A FLEXIBLE TRANSPORTATION SYSTEM PROVIDES A SECOND LEVEL OF EQUIPMENT INTEGRATION, WHICH MAKES IT POSSIBLE THROUGH REPEATED USE OF EVERY MACHINE TOOL TO RAISE THE WORKLOAD RATIO AND REDUCE THEIR NUMBER.

"One more problem is connected with the cutting tool. It rapidly breaks down owing to the conditions under which machine tools with numerical control have to operate. Taking this into account, the magazines of 'machining centers' ordinarily have several sets of identical tools, which are enough for a daily cycle. But if we want to increase this period to weeks, months and even years, then we should take care of automatic replenishment of tools in the magazines themselves. The necessary AUTOMATED CUTTING TOOLS SYSTEM (AIS) PROVIDES A THIRD LEVEL OF INTEGRATION, WHICH MAKES IT POSSIBLE TO INCREASE THE LENGTH OF 'UNMANNED' OPERATION OF MACHINE TOOLS TO PERIODS THAT ARE LIMITED BY THEIR RELIABILITY ALONE.

"Such equipment integration opens broad possibilities in production. If, for example, it is necessary to manufacture several different components, the controlling electronic computer can start them up one after another, synchronically relaying corresponding processing programs to every machine tool. Much simpler components will be processed in parallel, for which purpose an electronic computer will divide 'its' machine tools into prearranged, as if independent groups. Finally, during a breakdown of one of the machine tools, an electronic computer will immediately distribute its duties among other machine tools.

"In short, SEVERAL FLEXIBLE TECHNOLOGICAL MODULES, UNIFIED BY CONTROL FROM ONE ELECTRONIC COMPUTER AND AUTOMATED TRANSPORTATION AND TOOLS SYSTEMS, CONSTITUTE A UNIFIED FLEXIBLE TECHNOLOGICAL COMPLEX (GTK). In order to readjust it to manufacture new articles, it is sufficient to introduce a corresponding program into the central electronic computer.

"By ensuring three-shift operation in automatic regime, such complexes made it possible to raise labor productivity threefold-fourfold, increase the equipment workload ratio to 0.85-0.9, reduce the component processing cycle twofold-threefold and reduce production costs threefold-fivefold. At the same time, the need for machine tools with numerical control is reduced by 2-2.5 fold and production areas are economized correspondingly."

[Question] "But will these indicators cover the high expenditures involved in the development of flexible technological complexes?"

[Answer] "An answer to this question can be provided in a specific example. In designing the ALP-3-2 complex we have set ourselves a task: it must turn out 6,600 base components of 50 different kinds annually. For their manufacture before it was necessary to have 16 machine tools of the 'machining center' type, which operated autonomously. Within the framework of the complex, as it turned out, it was sufficient to have eight similar machine tools for this purpose. Forty-seven instead of the former 91 people can handle them now during a three-shift operation. The component manufacturing cycle is reduced from 45 to 6 days. Correspondingly, the advantage from introducing the complex consists in the main in economizing on the fixed capital, on wages and by reducing trolling electronic computer, automated transportation and tools systems, the annual economic effect totals more than R700,000."

[Question] "What more is needed? What distinguishes such complexes from FMS--flexible manufacturing systems?"

[Answer] "A lot. Flexible complexes are essentially 'dependents'--their work is ensured by many services, subdivisions and shops of an enterprise. Beyond the complexes, technology and controlling programs are being developed, necessary instruments and equipment are being developed and made, unfinished work pieces are installed on 'satellites' or placed in special containers and tool magazines are being equipped. Most of these operations are performed manually at great labor cost. But the main problem is that a delay in any of them deprives the complex of the possibility to change to processing new articles."

The Final Goal

[Question] "The degree of technological flexibility required by an enterprise depends on the character of production being turned out. Apparently, preparations for mastering many innovations can be made in advance."

[Answer] "In some cases the question is posed extremely hard: PRODUCTION MUST BE POTENTIALLY READY AND CAPABLE OF CHANGING TO THE OUTPUT OF NEW OR MODIFIED PRODUCTS AT ANY MOMENT AND IN A SHORT SPACE OF TIME. For this purpose, based on the principles of flexible technology, it is necessary to automate all operations that go into engineering and into the technological preparation for production. In other words, to develop auxiliary flexible complexes with their own computer aided design systems (SAPR). These complexes can be unified into an automated production preparation system (SPP), which is capable of serving several technological complexes.

"Hence it may be said that FLEXIBLE MANUFACTURING SYSTEMS (FMS) ARE A STRUCTURE OF SEVERAL FLEXIBLE TECHNOLOGICAL COMPLEXES (GTK) WHICH ARE SERVED BY A FLEXIBLE PRODUCTION PREPARATION SYSTEM (SPP). The central electronic computer automated control system (ASU) of an enterprise, ensuring a link-up of planning-control computations directly with production control.

"Let us say that we take a shop engaged in the production of reduction gears as an example of the flexible manufacturing system. On receiving an order to produce a new model, its central electronic computer connects the automated design system for developing the design. Results of these computations will be used for solving the task of how to 'wedge' manufacture of the new model into a single flow with those already being produced. Finally the central electronic computer will schedule the manufacture of pinions, shafts, cases and other components for individual flexible technological complexes. And the latter, in turn, connect to this task the auxiliary complexes of the production preparation system. The central electronic computer informs on the readiness to begin production of the new reduction gear to the automated control system of the enterprise, which must ensure the supply to the shop of unfinished work pieces and complements..."

[Question] "What fundamental difficulties restrain the appearance of flexible manufacturing systems?"

[Answer] "It probably can be said today that the principles of developing flexible manufacturing systems are already known. The road to their realization is through further improvement of flexible complexes, for which it will be necessary to solve quite a few complex technical problems. Among them I would put to the forefront the problem of software--those algorithms and programs which make the use of advantages of an electronic computer possible. The complex control, organizational and design task in flexible complexes and flexible manufacturing systems must be solved, as they say, on the run--during the process of production.

"Questions of reliability also require special attention. One of its indicators in technology is the so-called mean-time-between-failures--the time before the first breakdown. If in the relative value it is taken as a unit for ordinary universal machine tools, then for machine tools with numerical control it will equal 0.4-0.6 and for robotized modules 0.3-0.4. And for automatic lines it can reduce to 0.25-0.3. This reduction in reliability is caused by the complex and multicomponent nature of designs, which are an order of magnitude higher for flexible manufacturing systems. Nevertheless, in order for the flexible manufacturing systems to operate at full efficiency, their mean-time-between-failures must be 8-10 fold greater than for universal machine tools.

"Moreover, during failures the flexible manufacturing systems must restore fitness for work, go to say, on the run, or at least as well as universal machine tools. Otherwise work stoppages will 'eat up' their advantages.

"Of course, the reliability of flexible complexes and flexible manufacturing systems depends to a great extent on the reliability of equipment and devices

that go into them. Specifically, the length of continuous work of numerical control systems must be brought to 2,000-3,000 hours. The reliability and resources of electronic computers have to be brought up to the 10,000-20,000 hour goal. And the reliability of cutting tools must be raised threefold-fourfold."

In the Focal Point of Programs

[Question] "In essence the question is about fundamental retooling of entire diversified machine building industry, which will require enormous expenditures. These can be reduced only through efficient organization of all work--coordination of research and development, specialization and cooperation of production and stage-by-stage transition to increasingly more flexible complexes and systems. It is in fact for this purpose that a decision on all-union programs for flexible manufacturing systems and automated design systems was adopted. What kind should they be?"

[Answer] "In my opinion, these PROGRAMS SHOULD ORGANICALLY COORDINATE TWO BASIC DIRECTIONS OF WORK--DEVELOPMENT OF FLEXIBLE COMPLEXES AND FLEXIBLE MANUFACTURING SYSTEMS ON A FUNDAMENTALLY NEW, GRADUALLY DEVELOPED TECHNICAL BASE AND INTRODUCTION OF FLEXIBLE TECHNOLOGICAL COMPLEXES FROM EQUIPMENT THAT IS IN OPERATION AND IS BEING PRODUCED. The situation today is such that attempts to develop flexible complexes are undertaken not only by scientific research institutes [NII] and design bureaus [KB] of many sectors but by individual enterprises as well. Their striving to master the advantages of flexible technology more rapidly can only be welcomed. But in this case it is necessary to eliminate the danger of appearance of crude and ineffective solutions and a mass of 'half-baked' devices and units whose manufacture, servicing and repair will require excessive expenditures. The fact that this 'initiative from below' surpasses scientific recommendations and standard determinations, which could direct it along a unified course, also puts one on guard.

"From this viewpoint one of the foremost tasks consists of working out a unified scientific strategy for developing flexible systems within briefest possible periods as well as norms that are compulsory for all which ensure link-up of equipment and its unification and the possibility of replacing existing units with more improved ones. In this case A BLOCK-UNIT PRINCIPLE OF DESIGNING FLEXIBLE MANUFACTURING SYSTEMS ON THE BASE OF STANDARD SERIES OF DEVICES AND EVEN OF THEIR UNITS MUST BE USED AS A BASIS OF SCIENTIFIC AND TECHNICAL STRATEGY.

"The question is about developing an 'elemental base' of flexible manufacturing systems and developing and organizing production of units and blocks from which it will be possible to put together multioperational machine tools and other industrial equipment, controlling devices for all flexible manufacturing systems and automated transportation and tooling systems with their robots, robot cars and warehouses. Special attention will have to be devoted to developing systems for controlling machining accuracy, wear and tear of the tools directly 'on the run', and for diagnosing the condition of equipment and controlling devices.

"The development of most of these components of flexible manufacturing systems in essence constitutes an independent scientific and technical direction. Accordingly, for each one of them it is also necessary to have scientific and technical programs, many of which will be of an intersectorial character. Besides, it is unlikely that broad production of necessary equipment can be implemented without enlisting enterprises of many sectors. Therefore, AS REGARDS BASIC DIRECTIONS, CONNECTED WITH DEVELOPMENT OF TECHNICAL MEANS OF FLEXIBLE MANUFACTURING SYSTEMS, IT IS EXPEDIENT TO HAVE LEADING DESIGN ORGANIZATIONS HEADED BY GENERAL DESIGNERS. They should be provided with sufficiently broad authority. First of all, as regards questions linked to implementation of the block principle..."

[Question] "Unfortunately, a conclusion can be made in the example of the same robotics that the block principle has been making its way in life with difficulty. Quite often owing to purely prestige considerations, sectors have been developing 'their own' robots and 'their own' controlling and other devices. There are few who consent to produce 'faceless' blocks for numerous enterprises. What is the guarantee that it will be possible to implement this approach in developing flexible complexes and flexible manufacturing systems?"

[Answer] "An understanding that only the block principle will make it possible to solve the assigned task with minimal expenditures of manpower and means should serve as a guarantee. The same machine tools, robots and even automatic lines can be used with equal success, for example, in motor vehicle and combine plants. But flexible complexes and flexible manufacturing systems embody a whole technological chain, whose features are often determined by the profile of a sector and even by specifics of production at a given enterprise. In other words, every specific case will require its own schemes and solutions. It is clear that the volume of design work can be reduced here only through broad utilization of standard blocks. In so doing, IT IS EXPEDIENT TO CONDUCT DEVELOPMENT OF SPECIFIC FLEXIBLE COMPLEXES AND FLEXIBLE MANUFACTURING SYSTEMS WITHIN THE FRAMEWORK OF SECTORS, BY ASSIGNING IT TO LEADING TECHNOLOGICAL ORGANIZATIONS HEADED BY GENERAL TECHNOLOGISTS..."

[Question] "But under such a scheme someone should be a guide of a unified scientific and technical strategy free of departmental influence. Perhaps, for scientific-methodical supervision of all work it is expedient to establish a state scientific research institute for flexible manufacturing systems under the USSR State Committee for Science and Technology and the USSR Academy of Sciences? One of the basic tasks of such an institute could be preparation of scientifically based proposals on long-range and controversial questions in the development of flexible systems, and also control over fulfillment of decisions adopted on these proposals."

[Answer] "I don't think that some institute can cope with such tasks. Most important of the arising questions can be solved only at the government level, and the current ones at the level of councils of general designers and general technologists. The preparation of proposals can be assigned to temporary commissions formed from representatives of various departments. A flexible management scheme should also help in the development of flexible systems..."

[Question] "Petr Nikolayevich, could you single out a general line in the strategy of introducing flexible complexes and flexible manufacturing systems?"

[Answer] "Probably it should consist of a striving, first of all, to convert interconnected systems to flexible technology. Let us say that an enterprise can make preparations today for the output of new production. But it cannot convert to it until related enterprises master new equipment. In order to avoid such dependence, many enterprises go back to 'natural economy'--begin to manufacture articles themsevles not according to specialization, which affects profitability of production. It is clear that the picture will change radically if all partners will have an opportunity to master innovations efficiently. In such approach FLEXIBLE TECHNOLOGY OPENS WAYS FOR DEEPENING SPECIALIZATION OF PRODUCTION AND ITS INTENSIFICATION ON THE SCALE OF THE WHOLE COUNTRY."

Still, the main significance of flexible manufacturing systems consists in the fact that by increasing labor productivity eightfold-tenfold they radically change the idea of its character. Operators of complexes, specialists in electronics, precision mechanics and precision drive and highly skilled adjusters become the main figures at an enterprise. Many of them will require not only secondary but even higher specialized education.

"We must persistently tackle the tasks of mechanization and automation of production also because of their social and political significance," Comrade Yu. V. Andropov stressed. "For, as a rule, a man rid of strenuous, arduous manual labor shows greater initiative and responsibility for the assigned task. He gets additional possibilities for study and rest, for participation in social work and in the management of production." It is for the sake of this that the party has set the task aimed at broad utilization of the advantages of flexible manufacturing systems.

9817
CSO: 1823/276

APPLICATIONS OF ROBOTS IN MACHINE TOOL INDUSTRY REVIEWED

Moscow SOVETSKAYA ROSSIYA in Russian 28 Apr 84 p 1

[Article by Nikolay Tyurin: "The Robot's Place in Production"]

[Text] The Orlovskiy Prompribor Production Association is a section that produces thermostats for domestic refrigerators. There is underscored neatness, cleanliness and ...almost a complete void of people. Only occasionally will the figure of an operator or repairman appear for a moment. But the steady hum of the equipment leaves no doubt that the plant is operating at full load. Yes, this is full automation and skillful application of industrial robots.

"Not long ago 40 people were engaged in assembly operations," tells repairman M. Khatevich, Honored Innovator of the RSFSR. "It is tedious, monotonous and exhausting work. But now, I maintain 10 robot complexes by myself. I am very pleased with my 'iron helpers'; their output is high, quality is excellent and no one complains about being tired. Or visit the adjacent galvanizing shop. There they transferred the soldering and welding of parts to automatic equipment and it immediately became apparent: for hazardous and difficult working conditions, you will not find a better worker than the robot...."

Needless to say, the Prompribor Association is not an exception. Last year there were over 7,000 robots and manipulators operating in our industry. If you consider that the annual rate of increase in the number of robots is approximately twice that of the previous year, it will become clear that today we are dealing not with visionaries' predictions, but with rapidly developing reality. By the way, up to now in conversations about robots the popularizer emotions sometimes overshadow specific problems of making robot equipment. At the Metalloobrabotka-84 exhibition, in which more than 500 firms from 23 countries participated, our science and industry demonstrated great potential and the production of leading domestic enterprises reconfirmed its high reputation. The contracts awarded speak expressively about this. Now the matter hinges on putting first-rate models of robot equipment on the production line.

This task is one of the main directions of the course toward production automation outlined by the 26th CPSU Congress. It a result of the logic of

developing science and industry, the increasing role of labor productivity and the demographic situation. Each of these factors now has special importance. But it is not without reason that the social and economic consequences of production automation are singled out. The new machines, equipped with an electronic brain, promise truly revolutionary changes in the sphere of labor--the leading sphere of human activities.

In the current five-year plan, the program of building model robotized complexes and the first automated shops is being successfully realized. The goals of the five-year plan are being over-fulfilled appreciably. Now the position held by the planning bodies in their time is bringing results--do not create greenhouse conditions for the robots, but incorporate them at ordinary plants. More than 100 new types of manipulators were developed in the last five-year plan and roughly half of them are now in series production. As a rule, these are robot-repositioners having one or two functions. Used mainly in machine-building sectors, they immediately had an appreciable effect. For example, labor productivity increased two-three fold and the equipment shift system doubled. But at the same time the robots presented industrial workers the problem of preparing the section, shop and enterprise as a whole for using such equipment. For a single robot is merely a high-priced toy. A system of machines is needed where it will occupy a legitimate place. An electromathematical control program is needed and special tools are necessary. All of this requires particular reliability and a steady level of production, without idle time and rush work. The experience gained shows that it is impossible to resolve these problems without a thorough and radical reorganization of the customary manufacturing method and traditional views toward those or other worker operations.

Yes, any robot, regardless of its specific purpose, becomes a unique indicator detecting the flaws of the surrounding equipment and processing method and the established organization of labor. If we want to obtain a high output from robot equipment, we must react energetically to each manipulator's "signal" about the nonconformity of production conditions with its "requirements". In the opinion of L. Snovskiy, chief of the Machine Tool and Tool Building Industry Department of the USSR Gosplan, the main goal today is improving management of production automation. As experience of recent years shows, this task is increasingly taking on an intersectorial nature. Let's say the Moscow Krasnyy Proletariy Machine Tool Plant begins production of the M-10 and M-20 robots this year. According to the specialists' estimates, they should in many respects help the development of FAP's--flexible automated plants--the plants of the future, where only the more advanced functions of control and adjustment are left to man. Since FAP's are already emerging--there are now about 16 of these systems operating in the country--the Krasnyy Proletariy workers must sharply increase production of robot equipment from year to year. However, the plant's chief engineer V. Boldyrev complains, the equipment parts that arrive are such that one can only make a helpless gesture. The quality of industrial rubber components, electrical work, electronics and many other things, outside of the Krasnyy Proletariy's sphere, needs to be increased considerably. How can this be achieved? How can the efforts of dozens of sectors be combined?

Of course, such questions do not mean that robot building does not have a program of development. Since 1972 this direction has been subordinated to the unified plan of the USSR State Committee for Science and Technology (GKNT). A scientific council "Robots and Robot-Technology Systems" is active in the USSR Academy of Sciences. Recently an interdepartmental commission on questions of introducing flexible automated plants into the national economy has been formed under the Gosplan USSR. Each of these measures, undoubtedly, is bringing its own results. However, today's experience and the boundaries of the future speak eloquently about the fact that this large-scale undertaking needs new and more effective forms of management.

The theoretists as well as the experienced workers of robot building believe that this problem is becoming especially urgent in connection with the emergence and development of flexible automated plants which are a new stage of robot technology. Most specialists are of the same opinion--a more precise coordination of all participants of this activity is needed. Recently, K. Frolov, corresponding member of the USSR Academy of Sciences and director of the Machine Science Institute of the USSR Academy of Sciences, had an article in SOVETSKAYA ROSSIYA. It's main conclusion was that financial resources and all scientific, planning and experimental work in this field should be centralized for successful resolution of the problem. The editorial staff received official responses from the USSR GKNT and Academy of Sciences which, in essence, merely stated the current management structure of robot building, but the main thesis of the publication was passed over in silence. Clearly, the question raised is not one which can be resolved quickly and simply. But we must start, especially since experience is giving reliable indicators, both on a sectorial and a regional level.

For example, the comprehensive goal-oriented program of development, production and assimilation of robots has become the pivot of the plan of re-equipping the sector for the Ministry of Instrument Making, Automation Equipment and Control Systems. It envisions the appearance of no less than 30,000 manipulators at instrument plants by the end of 1986, and this will be only the first major step toward robotization of the industry. What are the basic methods of realizing this program? The main scientific research institutes (SRI) and design buros responsible for development of the model projects have been determined. Measures are being taken for organizing series production of robot equipment at specialized enterprises. Territorial robotization centers are operating in the industry.

As for the regional management of resolving similar problems, the experience of the scientists and industrial workers of Leningrad has been instructive. The Coordination Council for Problems of Robot Technology, which includes managers and leading specialists of SRI's, design buros and production associations of the city, is in its seventh year of operation. The basic directions of activities are the same--strengthening interrelationships and concentrating efforts on the main aspects. The results of the comprehensive approach are available: nearly half of the types of manipulators operating at the city's enterprises were built by Leningrad workers and large robotized sections and shops are showing up at associations such as the Kirovskiy Plant, the Leningrad Electrical Machinery Plant and others.

Each of these examples shows what the efficient coordination of the numerous partners in the area of robot building can lead to. Today, when we are switching to building large robotized systems, it is obvious that we cannot do without a serious improvement of management methods here. There is no shortage in specific proposals by specialists. To select the most sound and make them the norm is very likely the most urgent task. As it was noted at the February (1984) CPSU Central Committee Plenum, the accelerated assimilation in production of the achievements of science and technology and the implementation of major comprehensive programs must raise the productive forces of our society to a new level. Robot technology and the skillful development of it is a major resource in this most important direction.

12567
CSO: 1823/253

JUSTIFICATION, INTEGRATION PROBLEMS WITH CAD NOTED

Moscow SOTSIOLOGICHESKAYA INDUSTRIYA in Russian 7 Apr 84 p 2

[Article by K. Britarev, director of the Scientific Research Institute of Machinery Manufacturing Technology, and B. Dolgopol'skiy, candidate of technical sciences and chief of the automated planning system department, Rostov-on-Don: "Economical Planning"]

[Text] One of the urgent tasks of today is increasing labor productivity of the engineer. Electronic computers and automated planning systems (APS) are helping to achieve this goal. Many organizations and specialists are engaged in their development and introduction.

Developments of the Rostov Scientific Research Institute of Machinery Manufacturing Technology (SRIMMT) prove the great potential of such systems. In particular, the system of automated planning of cold pressing and laying out of metal increases the labor productivity of a process engineer by 60-70 percent and reduces the planning time to between one-half and one-third. At the Orlovsksel'mash Plant alone, they are able to reduce metal input in this way by 300 tons compared to the original version of the engineering plan.

The planning system, developed within the precincts of the institute, has already been introduced at 14 plants and not only at enterprises of our Ministry of Machine Building for Animal Husbandry and Fodder Production. It is also being widely used in the Ministry of Machine Tool and Tool Building and other ministries. Overall, throughout the country the automated planning system makes it possible to save 1,500 tons of metal annually. More than 1,000 APS program modules have been developed for this, a major portion of which are general-purpose.

Great importance is being given at the national level to the problem of APS introduction. Today councils of chief system designers have been set up in every sector and an intersectorial council is operating. Taking into account the experience of the Rostov SRIMMT, the USSR State Committee for Science and Technology held, based on it, an All-Union Conference on Computerized Planning. The All-Union Scientific and Technical Symposium was held at Rostov-on-Don, with participation by specialists from Czechoslovakia and Bulgaria. All of this made it possible to exchange information between academic and industrial scientific research institutes and to work out

recommendations for accelerating introduction of promising scientific developments into the national economy. It was emphasized that automated systems have a direct effect on economical and careful management of the economy.

In this connection, it is very important to eliminate the existing difficulties in introducing the APS everywhere and to resolve all issues which arise. Take, for example, the economic evaluation of the system. Now its effectiveness is determined by comparing the two variations: planning by the traditional method and using electronics. Such an approach does not provide an objective result. Yes , "manual" planning does not require any capital expenditures, whereas expensive equipment is needed for the automated system. Naturally, in this comparison the economic indicators of the APS seemingly lose. You see, the cost of one hour of a process engineer's work is much cheaper than on an electronic computer. But, first of all, the equipment is used more than once. Secondly, the time factor is overlooked in the evaluation. But it is also important for the national economy which is deeply interested in the most rapid production of new machinery and mechanisms.

Unsuccessfully resolved matters of processing method standardization also affect matters. The numerous standards of the Unified System of Technological Production Preparation, in our view, rigidly and not always justifiably regulates the form of technological documents, while unclear interpretations of technical terms and description methods are permitted in planning the manufacturing process itself. This also makes it difficult in determining the circulation of the automated planning system.

We performed a very curious experiment. Five plants of the sector producing the same type of products and having similar equipment were asked to write a manual manufacturing process for making the very same part. Well, each of them turned out differently. Even the operation of laying out the sheets in strips was described by a different number of steps and, naturally, words. What is so significant is that the strictest control norm could not detect a direct violation of the standard which just permits different interpretation. In such a situation, determining the circulation of the automated planning system is reduced each time to a substantial transformation of it and this must not be.

Much work is already being done on standardizing the APS's themselves. However, here also one sometimes has to deal with essential useless documents. So, the All-Union Scientific Research Institute of Standardization in Machine Building prepared the first edition of methodical recommendations on the system. About 100 pages in this document are devoted to the pseudo-scientific discussion of the non-existent problem of selecting the stages of its development. But in practice the developers never have trouble in this matter.

Attention should have been given to the fact that now many of the rules of drafting designs and notations for them have been unjustifiably complicated and undergo continuous changes, which impedes design work in general. Seemingly, the time has come to develop new machine-oriented methods of

graphic documentation, simpler than now used, and legitimize them in the standards.

We must also note the so-called "psychological barrier"--skepticism in the new and a hidden desire to work as before. To overcome this, we must first of all think about how to change the nature of the process engineer's professional thinking. You see, in this case we are not dealing with the automation of individual planning procedures, but with a new form of engineering activity. The process engineer must learn to conceive of qualitatively different categories and concepts, to now the capabilities and means of the system and to use them skillfully. It is a matter of bringing the engineer and electronic computers together and eliminating the middleman--the operator. Computer technology in our time is becoming for him the same customary tool as a slide rule or calculator.

So, already today we must mould a new type of specialist: a process engineer-operator or designer-operator. An engineer must be taught programming and operator work in higher educational institutions and at institutes for improving qualifications. We must acknowledge that these educational institutions are not yet coping with such tasks.

All that has been said, naturally, does not exhaust all the problems and complexities connected with the introduction and widespread use of automated planning systems. But without their resolution, the entire matter will remain dependent on the good will of the plants' technical services. But in the interests of technical progress, this system must become a production necessity.

12567
CSO: 1823/266

WEAKNESSES OF UZBEKISTAN'S AUTOMATION ELECTRONICS SECTOR

Tashkent EKONOMIKA I ZHIZN' in Russian No 2, Feb 84 pp 25-28

[Article by N. Muminov, deputy general director of the "Kibernetika" UzNPO UzSSR Academy of Sciences, doctor of technical sciences, "Barrier on the Road to Developing ASU"]

[Text] Our goal is to provide for the growth of social production by raising the productivity of labor.

A radical way to solve this problem is the introduction and development of the automation of managerial activity everywhere, and the optimal utilization of the unlimited possibilities of modern computers.

Regrettably, the level and rates of development and introduction of an ASU [Automatic control system], as a whole, for individual sectors of the national economy of the republic and, especially of the automation of complicated technlogical processes (ASUTP) still do not meet the requirements of the day.

This is so for many reasons. We will separate them out here. The main ones:

-- weakness of the test and experimental base;

-- scarcity of professional cyberneticists as well as the unsatisfactory training of engineer and technician management in the area of automation;

-- insufficient level of typicalizing design developments in creating ACU for various purposes which increases their cost and, naturally, reduces the efficiency of the system. (Perhaps only the Tashkent PKB [Planning design bureau] ASU) may serve as an example of a comprehensive systematic approach to preparing ASU projects);

-- finally, there is still a certain psychological rejection of the ASU by individual ministries, departments, enterprises and organizations. Their managers do not speak openly against using modern computers for control, they even acquire them now, but use them inefficiently. There are a number of instances where expensive computers are loaded only several hours per day, doing simple operations that could be done successfully even on simple microcalculators.

In the 10th Plan period and in the three years of the 11th Plan period, hundreds of various levels of ASU were created and are functioning in Uzbekistan; today there are over 100 computer centers. But, frankly speaking, in the country and in our republic as a whole there are far from all cybernetic facilities, required for the efficient functioning of the ASU which are designed and manufactured at the proper technical standard, in sufficint numbers and of the required quality. This is unavoidably reflected in the efficiency of the created systems.

Further successes in developing ASU for various sectors of the national economy of the republic depend greatly on the quality of the technical facilities. Therefore, it is urgently necessary to renovate the existing computer park and use small-computer systems more widely. One of the most important problems is to organize,in the republic, the production of nonstandard cybernetic equipment -- sensors, converters, displays, special computers, microprocessors, i.e., equipment that ties series manufactured computers with objects of control. As times goes on, the efficiency of the ASU and of the entire republic ASU (RASU) as a whole will be more and more the determining factor in creating a production base for the output of such equipment in the republic.

Computers do not have enough facilities to communicate with objects of control and there are no accurate measuring devices and accessories for automating many technological processes. It is necessary to equip control computers with expanded immediate-access and external memory units. There are not enough magnetic disks with capacities of 100 or more megabytes, displays and other peripheral equipment. The Union enterprises that manufacture such equipment are not capable so far of satisfying the increasing demand.

In our opinion, the time has come to start developing program-equipment complexes for introducing RASU, in particular for the automation of technological processes. We are speaking of sensor systems changeable within wide limits (as required by customers), as well as actuators, communications facilities between objects of control and minicomputers (oriented toward ASU) and large universal computers. This equipment must not be supplied to the system piecemeal but in complete sets, including not only the needed devices or cable, for example, but also special programs as applied to the goal of the complex for controlling its operation, including control of data banks, various methods of interrogating sensors etc.

A powerful experimental plant must be built to develop, supply, install, and adjust such complexes. Its specialization and cooperation must be clearly defined with other associations and enterprises responsible for the development and manufacture of nonstandard cybernetic technical facilities, computers and other equipment, necessary for the ASU. Such an organization would make it possible to eliminate primitive production methods and parallelism, it could implement the most labor-intensive part of the work on developing specific ASUTP [Automated systems for technological process control] at enterprises and associations, implement automated systems of scientific research planning-design work, plan and other calculations that are needed in the RASU.

The CP Uzbekistan Central Committee and the Uzbek SSR Council of Ministers are concerned constantly about increasing the production volume of standard and nonstandard equipment for the ASU in various sectors of the national economy.

At an assembly of active workers of the party organization of the republic, it was stated in particular: "Practice shows that in scientific research institutes that have experimental bases, labor efficiency of the scientists is 3 to 4 times higher than in institutes that do not have such bases Yet work is done slowly in the republic on creating and strengthening scientific-production and experimental bases, especially in academic institutes and universities. The Gosplan, the Academy of Sciences, ministries and departments of the republic must take immediate steps to create experimental and production bases for scientific establishments and vuzes. This question is very important and must be solved in the party and state manner."

Many ministries received these instructions as the order of the times, as the most important condition for accelerating the rate of scientific-technological progress and did not miscalculate. For example, the Ministry of Light Industry of the Uzbek SSR was one of the first to act on the proposal to develop ASUTP at the Fergana Textile Combine, and to accelerate the manufacture of nonstandard technical facilities for this system and participated in the construction of the "Kibernetika" NPO [Scientific Production Association] OEZ [expansion unknown]. Already at the end of last year, the first stage of the ASUTP for the spinning mill was introduced at the Fergana combine using an M-6000 control machine and nonstandard devices developed and manufactured by our association.

The Ministry of the Cotton Ginning Industry of the republic outlined a plan for this five-year plan period to develop and introduce an integrated ASU that spans receiving raw cotton at cotton gathering centers, an automated system for reprocessing the cotton, an ASUTP for primary processing of raw cotton, an ASUTP cotton plant, an ASU for the "Zagotkhlopkoprom" Association in three oblasts of the republic and an ASU for the ministry itself.

Preliminary calculations show that the requirements for nonstandard cybernetic equipment to introduce ASU in these two republic ministries for the current five-year plan period are as follows: for the Ministry of Light Industry -- 3 million rubles, and another further 6 million rubles; for the the Ministry of the Cotton Industry -- 5 and 10 million rubles respectively.

We have named only two sectors that have decided firmly to automate production control and technological processes. Agreement in principle for partial participation in the construction of the plant has already been given by the following republic ministries: food, local, furniture and the woodworking industry, the fruit and vegetable industry, geology, the Central Asia RR Administration, Goskomsel'khotekhnika, the Uzbek Civil Aviation Administration and a number of other interested organizations and establishments.

To satisfy all requirements in nonstandard cybernetic equipment it is necessary to accelerate the construction of an experimental-test base. According to directives, the plant must reach its rated capacity at the end of this five-year plan period. The trouble is that first, base construction is prolonged and, second, time introduces its corrections. The plant was designed without looking to the future while now it becomes evident that even when the plant is operating at full capacity, it will not meet all requirements.

Having determined the potential need of the national economy of the republic for nonstandard cybernetic equipment, we calculated the production volumes of the experimental-test plant for the current and following five-year plan periods. This calculation showed that by the end of 1985 about 60 million rubles worth of such equipment must be produced, while in the following five-year plan period almost double that.

The UzNPO "Kibernetika" has accumulated certain positive experience in developing and introducing adaptive control systems intended for higher accuracy and productivity of machining intermediate products and optimizing the cutting modes. Seven author's certificates have been received and three systems for adaptive control of metal-cutting machine tools were approved. Experimental tests indicate that the introduction of such systems at machinebuilding enterprises in the republic will make it possible to improve product quality sharply, increase machine tool productivity, save expensive metal and, in the final result, is the basis for creating ASUTP for machinebuilding production facilities. It is enough to say that the use of ten adaptive systems we proposed and tested out at only one machinebuilding enterprise will produce an average yield of over a half million rubles.

Our NPO has special status. We are under the jurisdiction not of the sector but under the Academy of Sciences of the republic. But this involves some complications. It is simpler for a Union Republic to provide its enterprises with material and equipment funds. For us it will be more difficult. In fact, special scarce materials are required to manufacture the finest cybernetic devices. This problem must be solved today, so that the plant will not suffer due to the lack of units and parts.

We deem it advisable that orders of experimental-test plants for the necessary materials and complementing products be privileged over orders of series production plants. Science is exceptionally profitable. Many scientific establishments in our republic have an indicator of tens and hundreds of rubles per ruble spent.

There is no question that our state finances science generously. But the creation of an experimental-test base dropped out of the financing plan. Without financing, our science is delayed in its work and work is frequently fruitless.

From this point of view, the experience of the USSR Ministry of the Electrical Equipment Industry merits attention. Here measures are specified which encourage the increase in the relative importance of experimental developments in experimental production shops. This wise strategy interests workers in experimental bases economically to cooperate more closely with investigators and designers, to create faster and test out the innovations they created.

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CSO: 1823/280